MODERN Machine Shop

A Magazine for Machine Shop Executives
HOWARD CAMPBELL, Editor

Vol. 4 OCTOBER, 1931 No. 5

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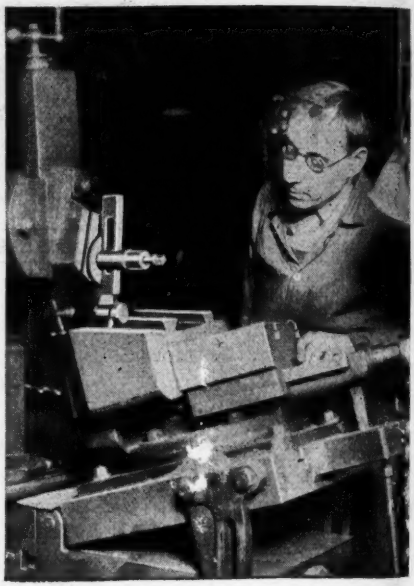

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MODERN Machine Shop

CINCINNATI, OHIO — OCTOBER, 1931 — VOL. 4, No. 5

The Magic of Modern Industry

Locating Defects and Causes of Defects By Means of the Radiograph — Determining the Hardness of Metals Through Crystal Orientation

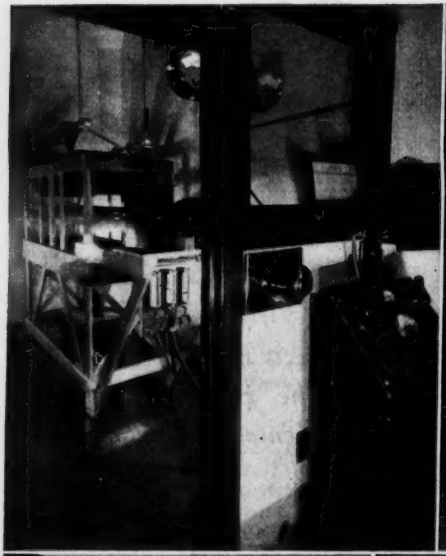
By PHILIP WINTER

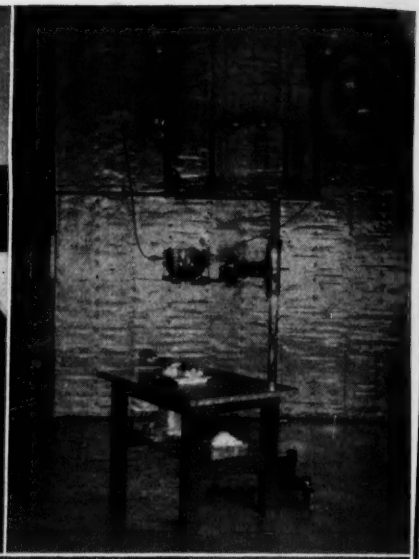
IF ONE of the ancient so-called magicians could drop in at the Claud S. Gordon Laboratories, 708 West Madison Street, Chicago, and see a photograph made of a defect in the interior of a solid block of metal—without cutting the metal—he would realize that the dream of centuries had come true. But it is being done every day, with iron, steel, aluminum, and practically all other substances.

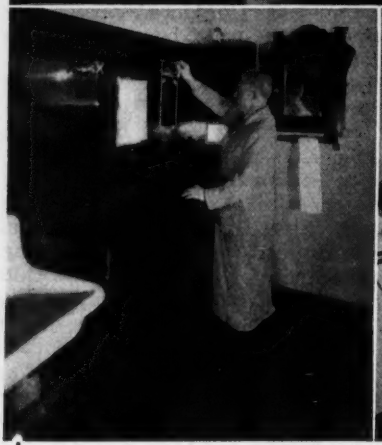
The use of the X-ray in modern industry has been discussed in Modern Machine Shop on previous occasions, and a great deal of interest in the possibilities of the process is evident. The number of firms who have actually installed X-ray equipment is still comparatively small, however, due to apprehension as to the cost of installing and operating such equipment. Thus many firms to whom such equipment would have been of vast benefit have been forced to get along without it. There are many such manufacturers who could make good use of the X-ray upon occasion, although the occasions might be few.

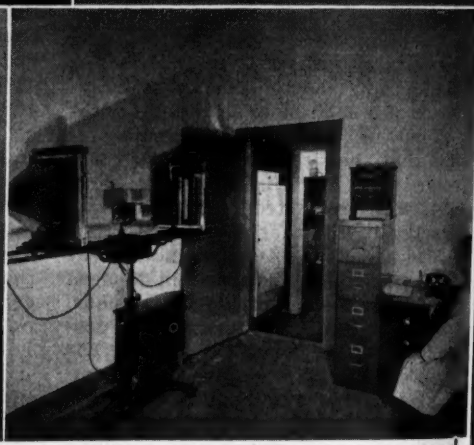
With a full appreciation of the possibilities for service in this connection, the Claud S. Gordon Company has equipped an X-ray laboratory for the general use of industry. Located at Chicago, which is convenient for most of the industrial United States, it can be reached within a few hours. The equipment is of the most modern type, and is so complete that any object from the size of a toothpick to the largest shipment that can be made on a flat car can be X-rayed, providing the thickness of the section is within certain limits. An X-ray photograph, or "Radiograph," as it is called, can be made through steel up to 3½ inches in thickness, and through 8 or 9 inches of aluminum. Other metals or materials are in proportion, according to atomic weight.

After Roentgen had discovered the X-ray, some thirty-five years ago, he used metals with which to demonstrate in his lectures upon the subject, but it was soon discovered that the human body could be penetrated much more easily than metals. The value of the X-ray in that field was quickly appreciated, with the result that the





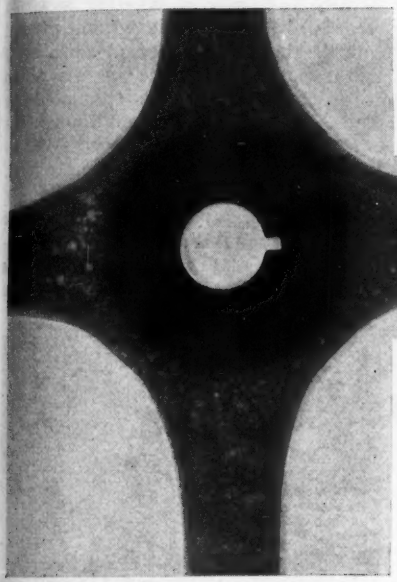




(Above—left)—Looking through the doorway into the machine room. The control board is located just outside the room, at a point where the operator can see into the tube room. (Above—right)—Interior of the tube room. The entire wall of this room is double lead-lined to protect the operator and others who may be in the vicinity. The window through which the tube may be seen at work is in the corner at the left. (Below—left)—One side of the dark room, which is considered one of the finest industrial dark rooms in the world. (Below—right)—Here is shown a part of the office, the plate-drying equipment, and a portion of the dark room.

(The above illustrations courtesy General Electric X-Ray Corporation.)

use of the X-ray grew in that direction. But slowly in the background, in the leading metallurgical laboratories of the world, experiments and development work have constantly been carried on until today the use of the X-ray machine is every-day practice.

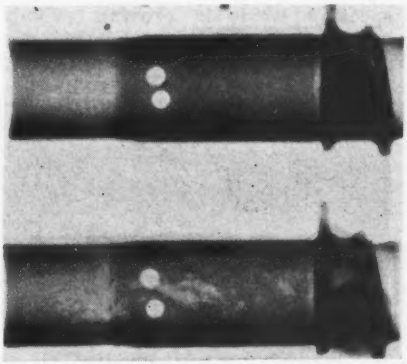


A radiograph of an aluminum alloy steering wheel spider that appeared perfectly sound. The light spots are blow holes in the interior of the casting.

One of the most important of the uses to which the X-ray has been put is that of discovering flaws in the metal parts that are intended for airplane construction. Undoubtedly many failures have been prevented and many lives have been conserved through the ability to make sure that the vital parts of the engine and structure are sound. However, it is just as applicable for use on other metal parts of all kinds, and at the present moment is finding great favor among foundrymen and welders.

In starting a run of castings in the foundry, it has been general practice to fracture the first few castings in order to determine whether or not there were any shrinkage defects or other faults that should be corrected before proceeding with the run. However, shrinkage defects sometimes appear in the most unexpected places, and often escape the eye of the inspector altogether even when the casting is broken. The modern method consists in radiographing either the complete casting or those points where defects are likely to occur or where the section of the casting may be changed, thus showing up any important defects and making it possible to eliminate them by changing the locations of the risers and gates. With this problem solved, it is an easy matter to produce sound castings, providing the melting practice is correct.

The weld is another type of metal fabrication with which a certain amount of chance had been involved, in the past, due to the fact that it has been impossible to tell, after a weld was made, whether or not complete fusion was obtained. Even those who



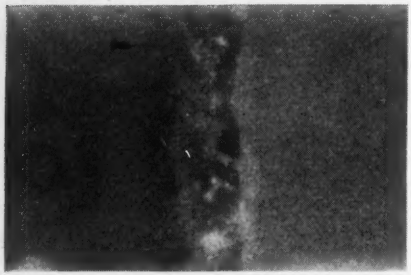
A radiograph of two bronze push rod guides. The upper one is perfect; the lower contains a number of internal defects.

are not familiar with the welding process can easily understand that a surface weld, in which the edges of

The iron casting from which this radiograph was made appeared to be solid. Note the defects, which were all under the surface.

the parent metal are covered over with welding metal without being fused together, is doomed to failure under stress, and the importance of a good weld can well be appreciated. One of the most common methods of determining the soundness of a weld has been to strike the surrounding metal with a hammer and try to determine by the resonance whether or not the metal was properly fused. The X-ray machine has, however, removed all uncertainty, and a flaw in a weld can now be located as easily as though it were on the surface.

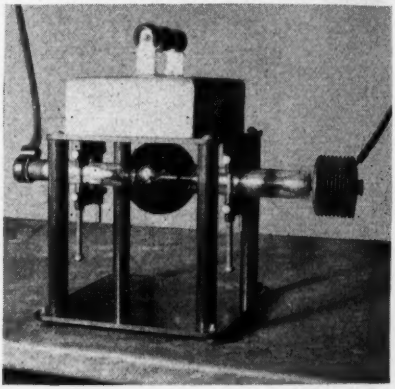
Welding is now used to a large extent in the construction of pressure vessels, and the X-ray method of inspecting welds is proving valuable both for examining the welded seams and for determining the qualifications



A radiograph of a badly-made weld. The light spots are flaws in the weld, not visible from the outside.

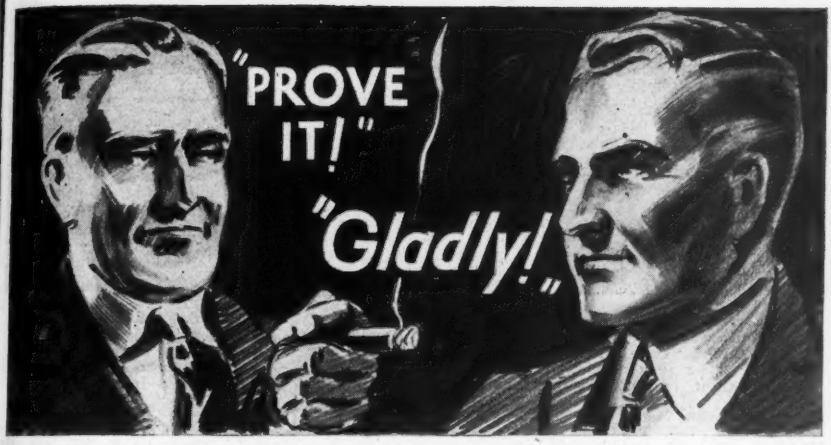
of welders. One large manufacturer of saws had radiographs made of saw welds that had been made by all the various methods of welding saws, in an effort to find out which method was the best. Another manufacturer had radiographs made of the seven different kinds of welds that could be made on his product, and found that two of the methods produced good results. The other five were uncertain.

One of the more interesting of the tasks that are a part of the day's work in the Gordon laboratories is the determination of the correct crystalline structure of metal by means of the

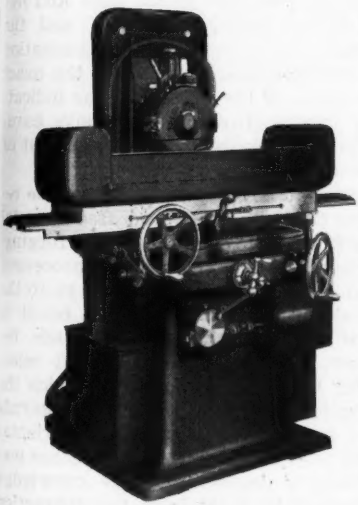


Von Laue diffraction equipment, with which the crystalline structure of metal can be determined. The radiograph magnifies the crystal from 2,000,000 to 6,000,000 times.

X-ray. In short, it is possible to magnify a section of metal from 2,000,000 to possibly 6,000,000 times and then take an X-ray picture of a section 0.020 inch in diameter. The resultant radiograph will show the relative position and condition of the atoms with each other, and thus make it possible to determine whether or not the metal or material is just in the right condition for the purpose for which it is to be used. The radiograph shows what is called the arrangement or orientation of the crystalline structure,



. . . . **and We Can!**



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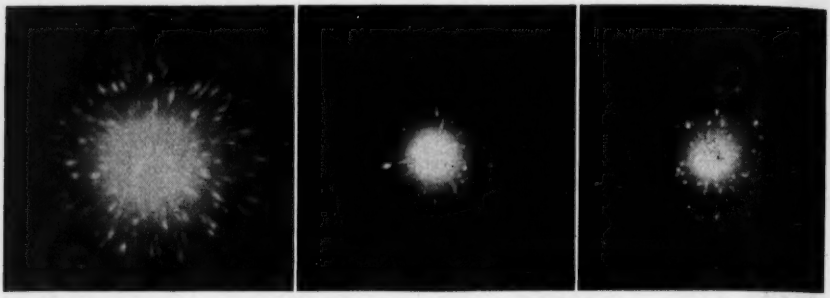

Radiographs of the structure of a piece of steel (left) as it came from the mill, (center) after heating to 1850 deg. and quenching in water, and (right) after heating to the same temperature and allowing to cool in the furnace. In the original state it was too soft, water-quenching made it too hard for the purpose, and furnace-cooling made it just right. Notice the comparatively even distribution of the crystals in the furnace-cooled piece.

which may be from a preferred to a random orientation, or from one extreme to the other.

The radiograph is obtained by the use of a small X-ray machine of a type that is known as diffraction or "Von Laue" equipment, after the discoverer of the process. The specimen to be radiographed, in a section approximately 0.003 inch thick, is laid over a 0.020 inch hole in a lead bushing in the support, the bushing being directly over the X-ray tube and immediately under the plate, and the current is applied. An examination of the radiograph will show the exact condition of the crystals, thus indicating strains, ruptures, excessive hardness, etc., through the arrangement or orientation.

Thus it is possible to follow the results of the various processes in metal working from the rolling or forging, through the heat treating processes, annealing, hardening, and so on to the finished product. The net result is that comparisons can be made between various materials, and selections made of materials in which the orientation can be made, or materials can be selected in which the orientation is identical with that in other materials, if desired. Or the knowledge obtained by a study of the diffraction patterns can be used to make improvements in the product. This is the cheapest kind of laboratory work, as no etching or polishing is required.

The X-ray has removed practically the last element of uncertainty from

(*Continued on page 85*)

AM. CHEM. SOC. ATOMIC WEIGHTS, 1929. (O = 16.)

	Sym-bol	At. no.	At. wt.		Sym-bol	At. no.	At. wt.
Aluminum	Al	13	26.97	Neodymium	Nd	60	144.27
Antimony	Sb	51	121.77	Neon	Ne	10	20.183
Argon	A	18	39.94	Neoytterbium = YTTERBIUM			
Arsenic	As	33	74.96	Nickel	Ni	28	58.69
Barium	Ba	56	137.36	Niobium = COLUMBIUM			
Beryllium	Be	4	9.02	Niton = RADON			
Bismuth	Bi	83	209.00	Nitrogen	N	7	14.008
Boron	B	5	10.82	Osmium	Os	76	190.8
Bromine	Br	35	79.916	Oxygen	O	8	16.0000
Cadmium	Cd	48	112.41	Palladium	Pd	46	106.7
Calcium	Ca	20	40.07	Phosphorus	P	15	31.02
Carbon	C	6	12.000	Platinum	Pt	78	195.23
Cerium	Ce	58	140.13	Potassium	K	19	39.10
Cesium	Cs	55	132.81	Praseodymium	Pr	59	140.92
Chlorine	Cl	17	35.457	Radium	Ra	88	225.97
Chromium	Cr	24	52.01	Radon	Rn	86	222
Cobalt	Co	27	58.94	Rhenium	Re	75	188.7
Columbium	Cb	41	93.1	Rhodium	Rh	45	102.91
Copper	Cu	29	63.57	Rubidium	Rb	37	85.44
Dysprosium	Dy	66	162.46	Ruthenium	Ru	44	101.7
Erbium	Er	68	167.64	Samarium	Sm	62	150.43
Europium	Eu	63	152.0	Scandium	Sc	21	45.10
Fluorine	F	9	19.00	Selenium	Se	34	79.2
Gadolinium	Gd	64	157.26	Silicon	Si	14	28.06
Gallium	Ga	31	69.72	Silver	Ag	47	107.880
Germanium	Ge	32	72.60	Sodium	Na	11	22.997
Glucinum = BERYLLIUM				Strontium	Sr	38	87.63
Gold	Au	79	197.2	Sulphur	S	16	32.06
Hafnium	Hf	72	178.6	Tantalum	Ta	73	181.5
Helium	He	2	4.002	Tellurium	Te	52	127.5
Holmium	Ho	67	163.5	Terbium	Tb	65	159.2
Hydrogen	H	1	1.008	Thallium	Tl	81	204.39
Indium	In	49	114.8	Thorium	Th	90	232.12
Iodine	I	53	126.932	Thulium	Tm	69	169.4
Iridium	Ir	77	193.1	Tin	Sn	50	118.70
Iron	Fe	26	55.84	Titanium	Ti	22	47.90
Krypton	Kr	36	82.9	Tungsten	W	74	184.0
Lanthanum	La	57	138.90	Uranium	U	92	238.14
Lead	Pb	82	207.22	Vanadium	V	23	50.96
Lithium	Li	3	6.940	Xenon	Xe	54	130.2
Lutecium	Lu	71	175.0	Ytterbium	Yb	70	173.6
Magnesium	Mg	12	24.32	Yttrium	Y	39	88.92
Manganese	Mn	25	54.93	Zinc	Zn	30	65.38
Mercury	Hg	80	200.61	Zirconium	Zr	40	91.22
Molybdenum	Mo	42	96.0				

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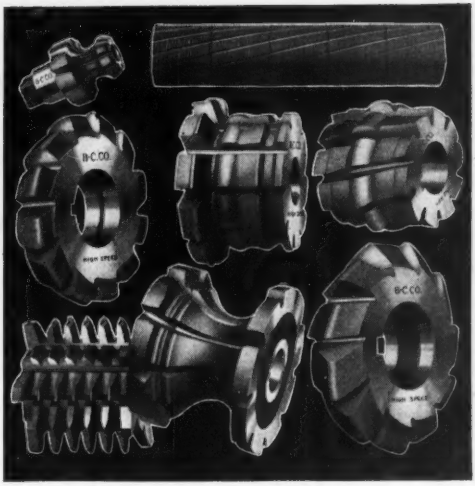

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BARBER-COLMAN COMPANY

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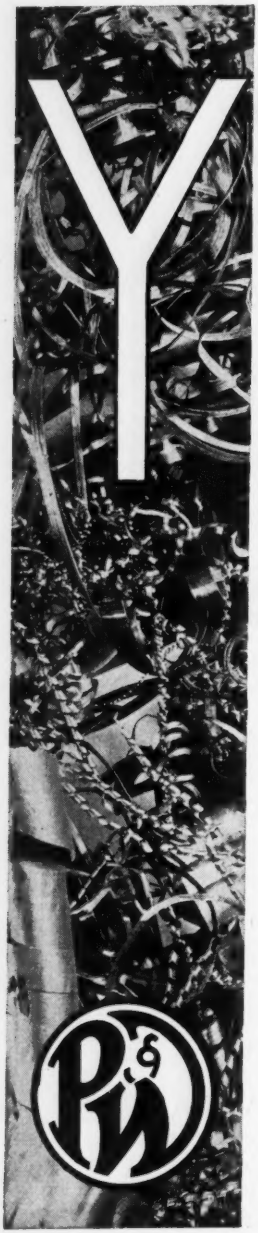
ROCKFORD, ILLINOIS, U. S. A.



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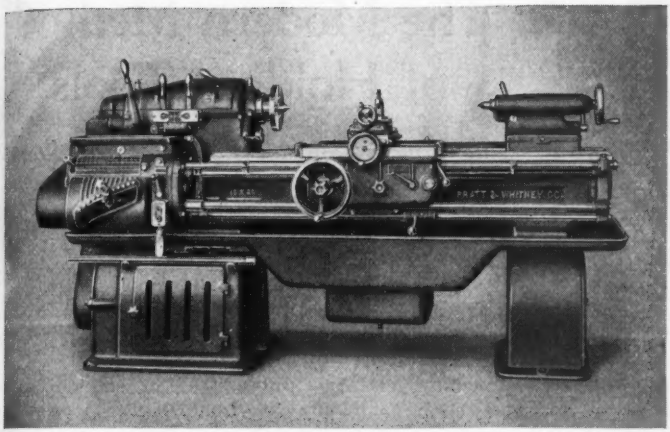

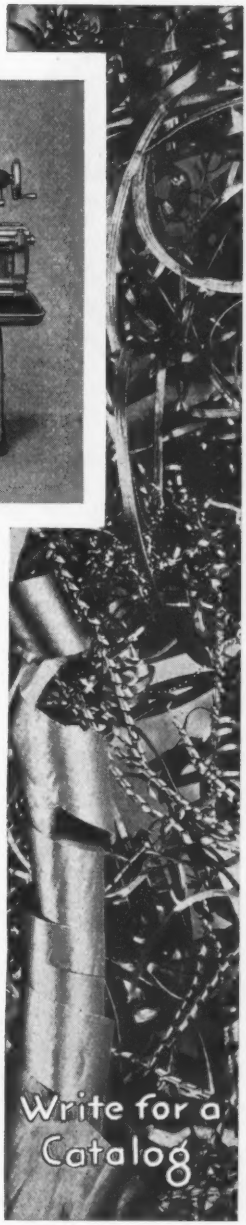

Can you see savings in such chips?

Chips as thin as ribbons, as dainty as lace, as smooth as a fine mirror—these tell of accuracy and precision work. Big steel chips that seem large enough to wreck a precision lathe yet do not cause a quiver in the Model B—these show that this lathe can take the day after day punishment of big feeds at high speed . .

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WHITNEY

The Modern Method of Holding Tools

The Chuck Represents a Simplified, Standardized, and Efficient Method of Holding Tools

By A. E. ENGLAND, M. E.
Chief Engineer, Jacobs Manufacturing Co.

IN ANY trip through a machine shop, one type of machine shop equipment will be found in evidence at every turn. The machine may be an engine lathe, a turret lathe, or an automatic lathe; it may be a boring mill, or a drill press, or an automatic screw machine, or an internal grinder—nine times out of ten it will be equipped with a chuck, either for holding the work or for holding the tool, or both.

Whenever an operation is to be performed with the aid of power, some method of holding either the work or the tool must be found by which the piece or the tool will be gripped rigidly and held against the enormous pressure set up by the machine. Special devices could be made for this purpose—and have been since the earliest history of machine work—but economy and convenience have demanded a holding device that could be used, as the human hand is used, to grip and hold anything within the range of its size. Thus was developed the mechanical hand that is commonly known as a chuck.

Generally speaking, there are two classes of chucks; the type that is intended to be fitted to an individual machine for holding work, and the type that is made with a shank for application to any machine that has a spindle, to hold the tool. It is with the latter type that this article deals.

The tool is the point of contact between the machine and the work, and the effectiveness of the tool is dependent no more upon the accuracy and efficiency of the machine than it is upon the accuracy and efficiency of the chuck in which the tool is held. In other words, "the machine is no better than its chuck." In a chuck that is properly designed and carefully made, gripping power and accuracy are combined with ease of operation. Such a chuck forms an ideal medium for applying a drill, reamer, center drill, or other tool to the spindle of any kind or type of machine. A variety of tools of different sizes may be used consecutively in the spindle of a machine by using chucks which reduce the shanks of the tools to a common size and shape.

In Fig. 1 of the accompanying illustrations an operator is shown performing a series of drilling, reaming, and tapping operations on parts for special production machines. The shanks of

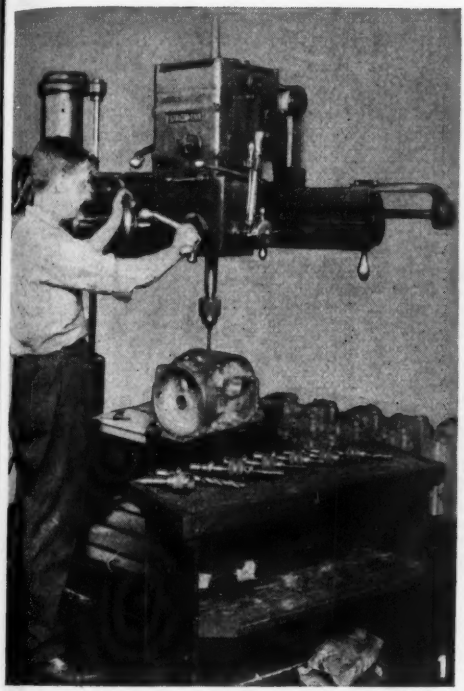


Fig. 1—The various kinds and sizes of shanks on these drills, reamers, and taps are reduced to a common size by the use of chucks.

the tools are of different shapes and sizes, but the operator has solved the problem of changing tools quickly by the simple expedient of using chucks to hold the tools. Thus all the tools are equipped with shanks of a common size and shape, simplifying the matter of using them with quick-change holders.

The advantages enumerated in the preceding paragraph have been recognized in the turret-lathe set-up shown in Fig. 2. Here three tools—a drill, a reamer, and a counterboring tool—are shown held by chucks which have been fitted with straight shank arbors that fit the holes in the turret. The tools are held accurately and rigidly, which are the first requisites of a tool holder, whatever the design. The chucks offer a decided advantage over special tool holders in that any one of these chucks can be used to hold any size of tool up to the capacity of the chuck instead of being useable on only one tool, as would be the case if a special holder were used. And—believe it or not—all these advantages can be had at a cost which would not greatly exceed the cost of making up a special holder. When the time that would otherwise be required for changing tool holders in changing job setups is considered, it is doubtful that the cost would be *any* greater—and time spent in changing tool holders means a loss in production.

Chucks for holding production tools are equally as adaptable to the screw machine turret, and will provide the same advantages. In Fig. 3 two chucks are shown in use on the turret of a Cleveland automatic screw machine, where the same size and type

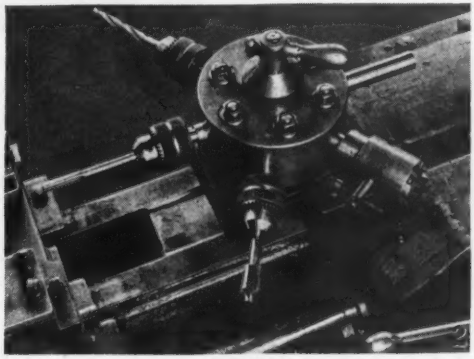


Fig. 2—The chuck as a tool holder can immediately be adapted to any tool up to the capacity of the chuck.

of chuck is used to hold drills of different sizes. These chucks have been fitted to arbors that fit the arbor holes in the turret, and as the turrets are standard, the chucks are interchangeable on all Cleveland automatics of this size.

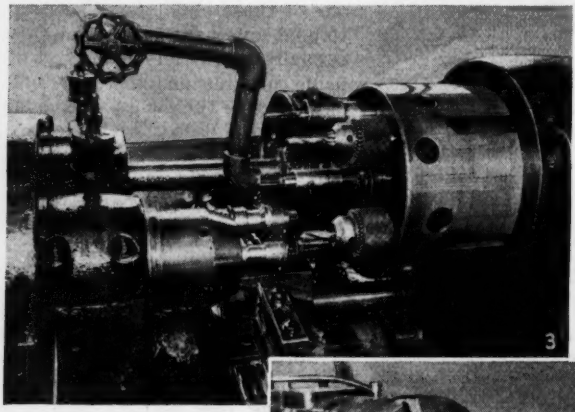
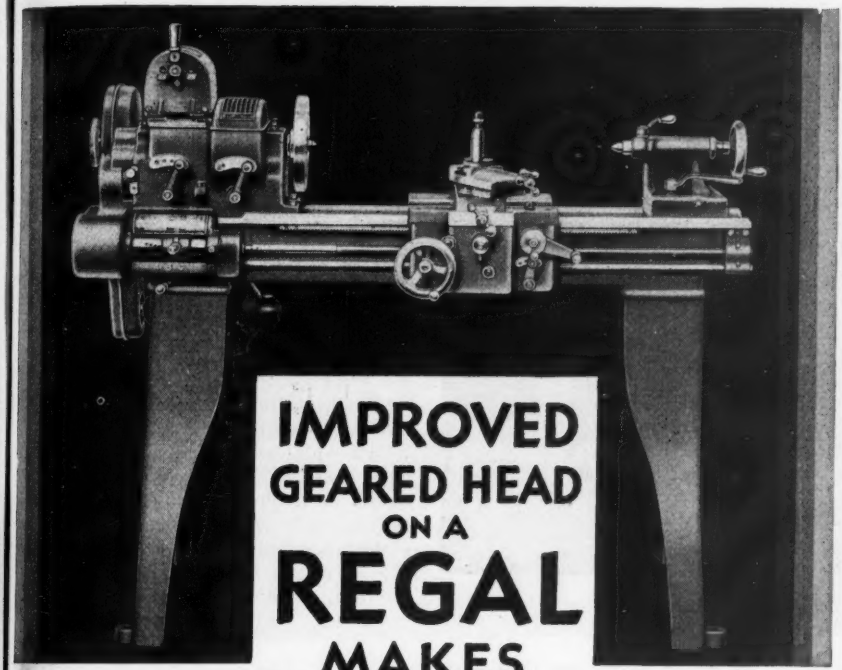


Fig. 3—Chucks can be equipped with standard arbors for use in turret lathes or screw machines. Fig. 4—By using a chuck in the tailstock of the lathe, the drill is held surely and accurately, and can quickly be changed for a reamer or other tool.

Figure 4 shows the use of a chuck for holding tools in the tailstock of an engine lathe. The operation calls for a hole to be drilled from the solid, after which the hole is bored and reamed. Although strictly an engine lathe job, means must be supplied for holding and feeding the drill and reamer into the work. It is more or less customary to hold the drill by running the tailstock center into the center hole in the end of the drill-shank, use a dog to prevent the drill from revolving with the work, and feed it by means of the tailstock spindle. But no one knows how many thousands of drills have been broken, how many pieces of work spoiled, and how many centers have been ruined by this method. The logical way to perform this task is to insert the shank of a chuck into the tailstock spindle and then hold the drill or reamer in the chuck. The tool will be perfectly centered, and can be fed into the work with no danger of spoiling the work, tool, or center. And the change from the drill to the reamer can be made almost instantly.

Figure 5 shows the application of a chuck to the headstock of a lathe for holding a burring reamer. The operator is reaming a burr out of a drilled hole where one hole is intersected by another, for which the r. p. m. of the reamer should be as high as possible. Hand reaming would not only be much slower, and more tiresome for the operator, but would also result in a much poorer job. This chuck is provided with a hole through the body, thus permitting the insertion of bars, rods, valve stems, or other work which must of necessity extend through the chuck-body and into the spindle of the lathe. Such chucks should be fitted to the headstock of the lathe with hollow



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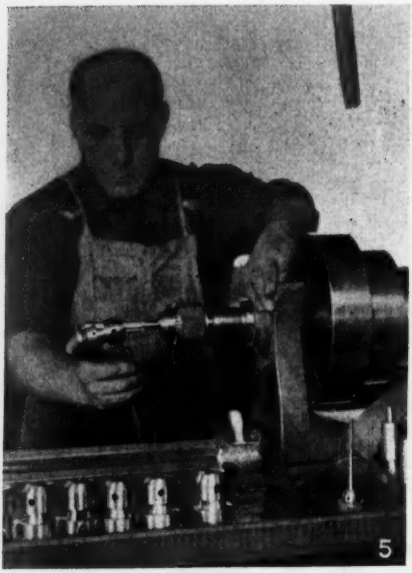

Fig. 5—Here a chuck is being used to hold and drive a reamer at high speed for hand-burring.

arbors, the arbor being provided with a nut so that the chuck and arbor may be readily removed from the spindle.

The convenience and accuracy of the modern type of chuck is often taken advantage of by experienced toolmakers, as evidenced by the set-up illustrated in Fig. 6. In this case the chuck is being used to hold a dial indicator and its attachment so that the artisan may be enabled to locate the center of the work in exact alignment with the spindle of the horizontal boring machine. The piece is a rotary table for a special high-production drilling machine, and the holes must be bored in exact relation to each other within limits of 0.0002 inch. Any experienced toolmaker will verify the statement that no toolroom equipment is complete without a supply of dependable chucks.

Another illustration of a chuck in use on a toolroom job is shown in Fig. 7, where the operation of milling flutes in a reamer can be seen. The blade end of the reamer is located on a center, and the other end (the shank end) is held in a chuck that has been applied to the spindle of a dividing head. The chuck serves both to hold the piece rigid while the cut is being taken, and to revolve the piece as needed for a new cut. The dependence that is placed upon the accuracy of the chuck is clearly evidenced here.

The convenience of the chuck as a toolholder is clearly brought out in Fig. 8, where a chuck can be seen in use for holding an end mill while slotting a part for a universal joint. All machine tools and attachments in which spindles are used are made with standard tapers into which the shank of a chuck fits naturally, consequently it is only natural that the experienced mechanic should turn to the chuck as a universal tool-holding medium when setting up a job. Indeed, the truth of this statement is

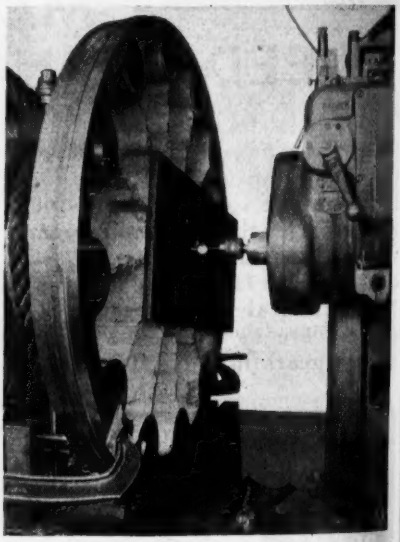

Fig. 6—The toolmaker would find it difficult to get along without dependable chucks.

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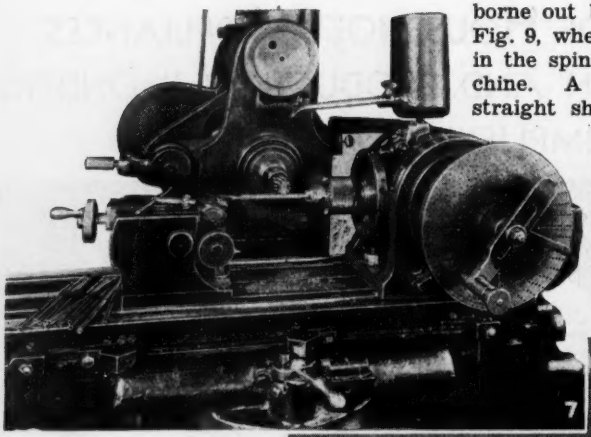

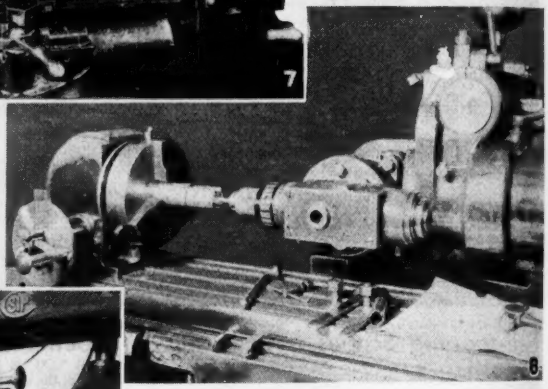

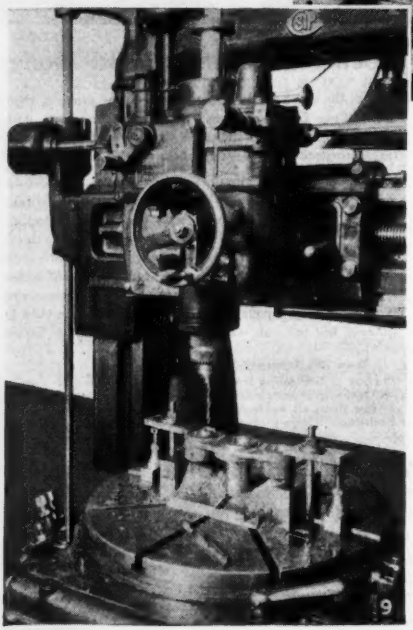

Fig. 7—The convenience and accuracy of the chuck is being utilized here for milling flutes in reamers. Fig. 8—Using a chuck to hold and drive an end-mill. Fig. 9—The accuracy of the machine is maintained by an accurate chuck.

borne out by the set-up shown in Fig. 9, where a chuck can be seen in the spindle of a jig-boring machine. A center drill and two straight shank drills of different sizes are in evidence on the machine-table—and this job is exactly as the photographer found it.

The day of makeshift manufacturing methods is past. A degree of accuracy is demanded in machine tools today that was not thought possible a few years ago, and it should be obvious to any thoughtful engineer that a machine—no matter how expensive—is accurate only in as far as that accuracy is delivered at the point of the tool. How often will a shop manager watch with pride the setting up of a new, modern machine that has cost thousands of dollars, and then allow the foreman to slip into the spindle a chuck that has seen its best days. All the skill and experience that have been combined in the designing and building of this fine piece of machinery have been rendered null and void for want of a chuck of the same quality as the machine—although costing but a few dollars. "The machine is no better than its chuck."

POLDI STEEL CORPORATION OF AMERICA

245-247 WEST 18TH STREET, NEW YORK, N. Y. — 1627 WEST AUSTIN AVENUE, CHICAGO, ILL.

GENERAL REMARKS ABOUT THE HARDENING OF STEEL

FUNDAMENTAL RULES FOR THE CORRECT HARDENING OF TOOLS

The steel should be heated slowly, uniformly and thoroughly until the whole section of the part to be hardened reaches the correct hardening temperature throughout. In this it should be exposed as little as possible to the noxious influence of the combustion gases and the air. The tool should be kept at the hardening temperature only as long as is necessary for a thorough heating.

The tool should then be cooled more or less vigorously but uniformly and in accordance with the requirements, in a hardening medium which is suitable for the steel used and the purpose in question (water, oil, air etc.).

The tool hardened thus should, if necessary, be tempered at the proper temper color.

MOST FREQUENT MISTAKES MADE IN HARDENING

TWO OR MORE MISTAKES MAY BE MADE AT THE SAME TIME; THIS SHOULD BE TAKEN INTO ACCOUNT IN JUDGING EACH CASE.

MISTAKES IN HARDENING	RESULTS OF MISTAKES AS SHOWN ON THE TOOL	APPEARANCE OF FRACTURE	HOW TO REMEDY THE MISTAKES MADE IN HARDENING AND HOW TO RENDER THE TOOL FIT FOR USE AGAIN IF CIRCUMSTANCES PERMIT
The tool was insufficiently heated, viz: not up to the proper hardening temperature.	Insufficient or no hardness; steel throws off scale imperfectly or not at all; it can be filed.	Is more or less the same as that of unhardened steel.	Hardening should be repeated at the temperature recommended for the quality and purpose.
The tool was heated too high, viz: to above proper hardening temperature, (overheated).	Sufficient hardness, steel throws off scale normally; it cannot be filed. The tool cracks easily in hardening and breaks in service owing to low toughness.	Fine to coarse grain, brilliant, in some cases glittering, at times stony.	If slightly overheated, the hardening should be repeated at a lower (proper) temperature. If considerably overheated, the steel should be given a thorough annealing prior to rehardening. The tool should be reforged, if the shape permits, — as in the case of chisels.
The tool was very much overheated, "burnt"	Sufficient hardness; steel throws off scale normally; it cannot be filed. The tool cracks very easily in hardening and breaks in service owing to great brittleness.	Coarse grained to coarse crystalline, brilliant white	A tool once burnt cannot be restored for, the
The tool was either decarbonized on the surface, owing to improper heating, or not sufficient stock or decarbonized surface removed in machining. See our catalogue for amount of stock recommended to be removed in machining.	Has apparently not acquired sufficient hardness, scale is thrown off imperfectly. Surface of steel can be filed, but under soft decarbonized layer frequently good hardness is encountered.	According to degree of decarbonization a more or less wide, glittering rim of the appearance of wrought iron, underneath good hardening grain corresponding to the hardening.	The decarbonized layer should be removed by grinding. If this be impossible or when the decarbonization is very deep the tool should be annealed, sufficiently machined and then hardened again.
The tool was heated too quickly and not uniformly	Hardness not uniform; tool can be filed in places; it cracks easily; corners and teeth chip off Large tools are likely to burst.	Grain structure not uniform - some portions appearing unhardened, others properly hardened and still others, especially corners and thin sections, often indicate overheating.	The tool should be thoroughly and uniformly annealed, then rehardened correctly.
The tool was not quenched vigorously enough (Quenched in too warm a medium; not large enough quenching bath, or isolating steam pocket between the tool and the hardening medium.)	Insufficient hardness; especially on large sections; edges mostly hard, but surfaces (especially large ones) can be filed, even where scale is thrown off.	Fracture shows good hardening grain on edges and thin sections, the remaining structure indicating unhardened or not proper grain.	Anneal the tool to break up the previous hardening grain structure. Repeat the hardening; quench vigorously by moving piece about in the bath, or by using sprays.
The tool was quenched in a medium acting too slow, (such as grease, air, etc.) for the quality and temper used and purpose intended for	Insufficient hardness; edges and thin sections sometimes hard, larger sections and surfaces soft; scale is thrown off imperfectly; steel can be filed in places.	Lack of uniformity of grain structure. The fracture in soft spots, appears more or less the same as unhardened steel.	Hardening should be repeated in a hardening medium acting more vigorously.
The tool was quenched in a medium acting too vigorously (such as salt water) for the quality and temper used, or the purpose intended for	Good hardness; scale is thrown off normally; steel cannot be filed. However, tool shows appearance of hardening cracks, or warping. The tool is too brittle.	Good hardening grain showing for a considerable depth and often through the whole section.	The tool should be more thoroughly tempered to relieve brittleness.

FRACTURE OF TOOL STEEL IN THE NATURAL STATE (NOT ANNEALED OR HARDENED). A good carbon Tool Steel fracture, in the natural state, possesses uniform grain structure of a dull gray color. A coarse grain usually indicates soft or low carbon steel, its grain structure becoming finer as the carbon content increases. Alloy Steels according to the composition generally show a more velvet like grain structure, than a carbon Tool Steel of equivalent carbon content.

FRACTURE OF PROPERLY ANNEALED TOOL STEEL. Through proper annealing the steel becomes more brilliant, the fracture more uniform and the size of the grain is somewhat reduced. It should be noted, that the brilliancy of the fracture is quite different from the glittering brilliancy of overheated steel.

FRACTURE OF BADLY ANNEALED TOOL STEEL. The fracture of insufficiently annealed steel looks more or less like that of steel in the natural state. Steel annealed too much shows a coarse, crystalline and very brilliant fracture. Steel exposed to the air during annealing shows a fracture having a decarbonized rim around the color edges very much like the appearance of wrought iron.

FRACTURE OF HARDENED TOOL STEEL. The fracture of properly hardened steel shows, as far as the hardened layer reaches, the finest grain which can be obtained, characteristic of the steel being treated. This grain structure is very fine and has a velvetlike appearance. To the eye there is almost no difference in the size and general appearance of the grain when comparing the hardened layers of soft and hard steels. The fracture of properly hardened alloy steel is marked by an especially fine and velvetlike grain structure. The depth of the hardened layer depends on the chemical composition of the steel and with some steels on the treatment as well.

CORRECT HARDENING TEMPERATURE OF STEEL. The lowest temperature at which the steel acquires uniform hardness, fine grain structure and sufficient depth of hardened zone is the one that should be employed. This temperature yields the best proportion between hardness and toughness of a steel. Heating to a higher temperature, the steel loses some of its toughness without gaining any hardness. The correct temperature is simply, is not the same for all steels.

CORRECT DRAWING TEMPERATURE or tempering color is the one at which the tool acquires sufficient toughness for the purpose and at the same time retains the highest possible hardness commensurate with tempering heat employed.

(A copy of this chart, wall size 27 x 19 in., can be had by addressing the Poldi Steel Corporation of America, 247 W. 18th Street, New York, N. Y., on your firm letterhead.)

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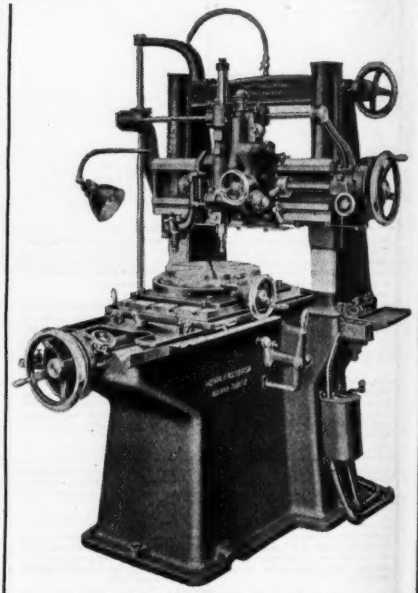

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Organizing To Eliminate Waste

Waste Can Be Eliminated By Properly Controlling the Various Factors of Management

By D. M. ARMSTRONG

WHEN waste is charged, the natural impulse is to place the blame on an individual and to direct the corrective campaign against that person rather than against the underlying causes for the condition. It is this very human tendency which has led us to say that management is responsible for a given percentage of waste, when as a matter of fact we really mean that some types of waste are the result of underdeveloped executive control, and that certain other wastes result from failure of the management to educate the workers in correct methods and principles. While in some individual cases loose personnel control may be to blame for management wastes, yet in a broad way the real cause lies not in the individual, but rather in the lack of a plan for securing tighter control.

The question naturally arises as to how the executive may develop a control which will, more or less effectively, minimize waste. The factors of management which must be brought under control to eliminate waste are:

1. **Organization Plan.** Every person must do the work for which he is best qualified and must know his responsibilities. Authority must equal responsibility and be clearly defined.

2. **Sales and Sales Distribution.** Control is gained through the use of analysis charts and the use of quotas. Sales must work in harmony with finance and production.

3. **Labor.** Waste is caused by idleness, by misdirected or unnecessary labor, by high labor turnover, and by lack of a complete record control.

4. **Material.** Waste is caused by poor material arrangement, by lack of material records, use of improper material, faulty methods of handling, and faulty purchasing control.

5. **Equipment.** Waste is caused by failure to use correct equipment or by faulty arrangement of equipment.

6. **Production.** Output can be increased by proper control over labor, material, and equipment. Uniformity of production and good record control over production decrease waste. Correct design is one element of production control and a knowledge of costs is the link between production and finance.

7. **Finance.** Waste arises from the failure to correlate sales and production with financial conditions. Lack of complete financial (accounting) records and the failure to use accounting records to reflect operating and sales results lead to incomplete executive control.

Organization is the first and most vital feature. How many businesses are able to define their organization plan? Comparatively few. It is surprising to find a company in which any sort of organization chart has been drawn, and it is remarkable that in many plants it is extremely difficult to chart the organization. One case is recalled in which the question was asked, "What are Mr. So-and-so's duties?" and the answer was given, "Oh, he is the general manager's nephew." Another example was that

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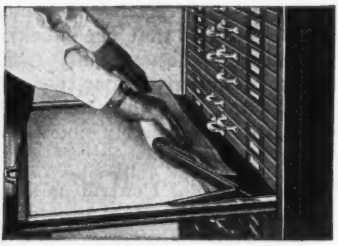

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of the company which had a "Sales Manager" and also a "Manager of Sales" and neither had any authority over the other, but both claimed full authority over the rest of the sales division. Perhaps the simplest way of showing organization defects is the mere listing of weaknesses which have repeatedly come to the writer's attention; naturally not a full list of possible weaknesses, but a compilation of some few of those which are outstanding and frequently found. Here they are:

1. One man controls the entire business.
2. No provision is made for an understudy who can carry on the business in the event of death or retirement of the main executive.
3. The control is poorly functionalized.
4. The control is poorly centralized.
5. The organization is physically decentralized.
6. The organization plan is indefinite.
7. The esprit de corps is poor.

Remedy For Organization Defects

The remedy for organization defects is, of course, dependent upon local conditions, but in general the following procedure may be adopted:

1. Analyze the organization as it exists and chart it in some easily understandable manner.

2. Study this chart, keeping in mind local conditions and personnel while making comparison with methods that have proved correct in similar companies or in business in general.

3. On the basis of this study, chart a proposed organization plan in which authorities will be clearly defined, in which control functions will be the governing influence rather than men or jobs, and which may be "grown to" by the present organization.

4. Take this plan up with the management, convincing them of the correctness of clearly defined functions, responsibilities, and authorities. Supplement the chart with written definitions of duties in case of doubt.

5. Use the agreed-upon organization plan as the basis upon which all other elements of management control will be developed.

The importance of a clear and correct organization plan cannot be overemphasized. It is the fundamental element of management control. What good does it do, for instance, for the general manager to call a meeting of department heads and state, "We are going to install a cost system," when no one knows who is to do the work or who is to be responsible for its success? Suppose he goes a step further and adds, "Mr. Smith will be responsible for the work." Yet, with a poorly defined organization, Mr. Smith, as accountant, will probably get into trouble with Mr. Jones, the shop superintendent, and possibly with Mr. Brown, the production manager, or he may find that the stockkeeper will take instructions only from the general manager. Under these organization handicaps the cost system's installation is probably doomed to an early death.

Proper Financial Control as a Factor in Eliminating Waste

The subject of organization is broad and comprises many details. Undoubtedly many of the details of both good and bad organizations will occur to anyone who thinks back over his own experiences. Fully as vital, however, and often more immediate and obvious in its effect upon the life of the business, is the subject of financial control.

Experience has shown that the following weaknesses in financial control of businesses are common, recurring time and again:

1. The company obtains no costs.

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HIGH speed machines need an oil that penetrates instantly—that distributes evenly to guard all working parts against friction.

Special blending from three oils—*animal, mineral* and *vegetable*—makes 3-in-One fill these needs far better than any plain mineral oil ever can.

Even at speeds up to 10,000 r.p.m., it clings to the bearings—guarding them against damage by friction; keeping them cool. And as it *oils* 3-in-One *cleanses* the moving parts of accumulated grit and dirt; also *prevents harmful rust.*

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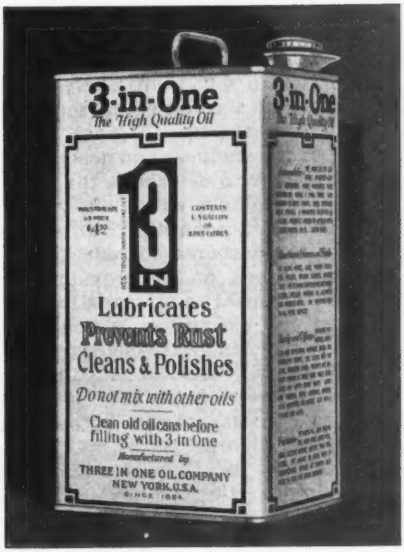

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2. Costs are incorrect.
3. Costs are not used as a basis to secure an operating control.
4. The accounting methods are poor.
5. Very little analysis or use is made of the accounting data secured.
6. Either the cost or the accounting system, or both of them, are over-elaborate.
7. The accounting results do not reflect actual operating conditions.

Remedy For Weak Financial Control

The remedial course to be taken where the financial control is obviously weak may be stated in a general way as follows:

1. Have an audit made, one purpose of which will be to analyze the accounts and accounting methods as a basis for revision.

2. Let the engineer and accountant work together to determine the feasibility of obtaining costs, of tying-in costs to the accounting controls, of shaping the accounts to reflect operating conditions, and of providing for regular financial and statistical reports to the executives, which shall be intelligible and valuable.

3. With a resultant installation program, approved by the management as a basis, let the accountant develop the detailed forms and methods necessary to accurate accounting records, while the engineer develops the interlocking details of cost, production, labor, material and equipment forms, methods, and records.

This is the phase of the work which is usually most difficult and sometimes the most discouraging. The engineer will have difficulty in working with the accountant because of the differences in viewpoint and in nomenclature. The engineer will find his desire to secure statistics sometimes blocked by the accountant's desire to secure penny-accurate figures. He will have to assume, as far as possible, the mental attitude of the managing executive in determining just what records and reports are most necessary, for very often the executive will have the vaguest ideas of what is desired. In this work the engineer requires more than technical skill and knowledge; he requires a sound business sense and a broad viewpoint of the business as a whole. He will do well to bear in mind also that these accounting and statistical records will be his instrument in proving the savings that result from the more purely engineering phases of his work, and that they should be capable of quickly and accurately providing this class of information when it is wanted.

Importance of Co-ordinated Accounting and Statistical Records

That "knowledge is power" is evident to those who are in position to see the practical usefulness of it as one sees the executive power of the recorded information that is provided by a well-co-ordinated system of accounting and statistical reports. Some of the startling examples of waste elimination that have resulted from the mere recording of facts for executive analysis are quoted, offhand.

Thus one company discovered (when all material was placed under proper inventory control) that nearly $100,000 in saleable product was stored around the plant in obscure rooms and corners. Still another company discovered from the material usage records that a certain ingredient—which cost in excess of $20,000 per year—was still being used in their product formula although the mechanical processing had been changed several months previously to eliminate the necessity of using this same ingredient. It is quite possible that other instances of a similar character may be recalled by the reader.

Often in the work of co-ordinating plant and accounting records it will be found that factory clerks are keeping daily records which are filed im-

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Naturally, a vital element in these machines is the flexible shaft. Accordingly HASKINS equips them with S. S. WHITE Flexible Shafts—shafts in which easy flexibility has been attained without sacrifice of strength; shafts that are true-running and that keep on running trouble-free over long periods, even in severest service; shafts that reflect in their finished quality the more than 60 years of progressive manufacturing experience back of them.

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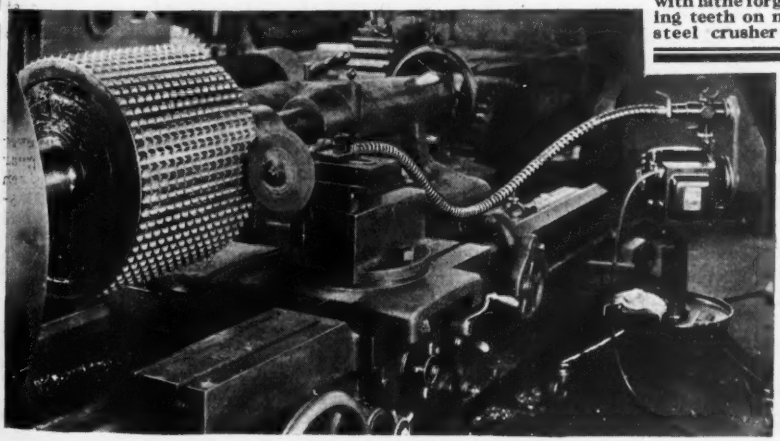

HASKINS HEAVY DUTY TOOL POST GRINDER equipped with S. S. White Flexible Shaft used with lathe for grinding teeth on nickel steel crusher roll.

mediately after and left to gather the dust of ages. In one company an entire cost department of four persons had been compiling partial cost data for more than three years, yet this data had never been used because the chief accountant "had no use for costs" and closed his books once a year on the basis of a physical inventory, while at his finger tips reposed the information which would have made possible a perpetual inventory, accurate monthly profit and loss statements, and detail costs on all products. The clerical waste of the time of four people for three years was the least of all the wastes, for when these costs were put to use and interlocked with the accounting controls, the management cut the inventory investment in half, discontinued several products that had regularly been sold at less than cost, and materially decreased the operating costs of several departments—something that should have been done years before.

Additional Controls For Elimination of Waste

Aside from the executive control which comes as the result of organization definition and rearrangement and as the result of proper accounting and financial-statistical records, there is also the control that is secured through the more usual engineering improvements. This means the establishing of material records, such as perpetual inventories, purchase records and usage reports. It means the co-ordinating of production with sales requirements, the possible establishment of sales and production and the best utilization of equipment. It means also the control of labor personnel and of labor distribution, and even merges into the factory engineering provinces of plant layout, power plant requirements, and so on. All of these sub-controls must be effective in themselves and must be brought to the executives in their more general phases, as a means of policy-shaping as well as operating control.

Control Must Be Co-ordinated

Only too often, however, each of these sub-controls is regarded as an independent unit, to be brought to a state of theoretical perfection regardless of its influence on other controls or on the business as a whole. This is the fault of the engineer, whose natural tendency is toward perfection of detail. Yet what is the real benefit in reducing direct labor costs 25 per cent if the total direct labor is only 4 per cent of the selling price, while distribution costs are left unchanged at 26 per cent of the selling price? The value of engineering work cannot be judged on the basis of immediate and provable savings accomplished by each system or operating change. The real test should be as to whether the change has resulted in more complete knowledge and control over some phase of the business. It must be assumed that with full and correct knowledge of all phases of the business a general manager may make that business profitable. If this assumption is wrong, then the remedy lies in providing a more competent manager, or if the manager is not at fault, the substitution of some more profitable line of business.

No Depression Here!

Two of the largest single orders ever placed for gear chamfering and gear burnishing machines were recently given the City Machine & Tool Works, of Dayton, Ohio. These orders were received from prominent automotive manufacturers and comprise 34 machines, each order being for 17 machines complete with all equipment. These orders, although resulting largely from present activity in Synchro-Mesh, Free Wheeling and similar transmissions, may possibly be interpreted as an encouraging sign to respective leaders in other fields of the machine tool industry.

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No. 55 D. S. (HEAVY)

A brute for strength and wear. Has 15" diameter, 16 gauge seat, concave and riveted to angle legs. Feet flare out; adjustable steel back rest. May also be obtained without back rest.

No. 55 D. S. (Heavy)

No. 66—13" diameter, 16 gauge seat, 6x9", steel back rest, adjustable, 28" and 30" heights, have double rows of stretchers. May be had without back rest.

No. 440 Stool—13" diameter, concave, 16 gauge seat, riveted to angle legs. Ball turned feet; rigid cross bracing; adjustable back rest.

No. 44 D. S.—16 gauge, 13" diameter seat; 6x12" steel back rest is adjustable and is riveted to spring steel pillars.

No. 66

No. 440

No. 44 D. S.

Any of these stools may be had either with or without the steel backs.

Heights: 18", 20", 22", 24", 26", 28", 30", 32", 34", 36"

No. 4

Write for a complete catalog "C-MMS" and price list. Complete stock patterns of all steel shop and factory equipment. We also build special equipment to your plans.

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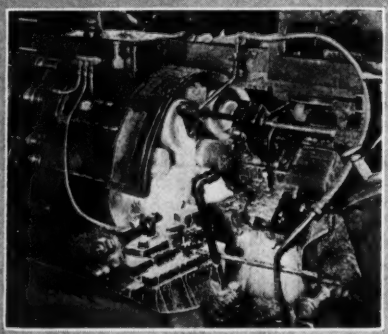

Courtesy of National Acme Company, Cleveland, O.

A CUTTING lubricant of known merit is necessary for machine efficiency. Frequent tool regrindings, work rejected through faulty finish and inaccurate tolerance, are factors that retard production. Production schedules are maintained by the use of Sunoco.

Automatics

OPERATION:
FACE SQUARE WITH HOLE WITHIN .00025 IN. BY INDICATOR.

MACHINE:
GRIDLEY 4 SPINDLE 4 IN. CHUCKING MACHINE.

MATERIAL:
MALLEABLE IRON.

CUTTING SPEED:
ROUGH AND FINISH FACE 131 FT. PER MIN.
ROUGH AND FINISH BORE 42 FT. PER MIN.
ROUGH AND FINISH TURN 131 FT. PER MIN.
ROUGH AND FINISH REAMING 43 FT. PER MIN.
ROUGH AND FINISH CHAMFER 131 FT. PER MIN.
OIL GROOVING.

SPINDLE SPEED:
186 R. P. M.

LUBRICANT:
1 PART SUNOCO TO 10 PARTS WATER.

Sunoco is adaptable over a wide range of operations

The superior cutting qualities of Sunoco make it ideally suited for present day production demands. Its lubricating, heat-absorbing and rust-preventing characteristics are responsible for its almost universal use as a cutting lubricant by the metal cutting industry where economy, speed of production and quality of finish are the requirements of efficient operation.

Sunoco reduces "time out" for tool resharpenings; it decreases rejections and as a result the production of accurate work increases even under identical feeds and speeds.

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Grinders

OPERATION:
ROUGH AND SEMI-FINISH GRIND ALL OVER ON GRINDING WHEEL SPINDLE.

MACHINE:
14 IN. BY 48 IN. CINCINNATI PLAIN SELF-CONTAINED GRINDER.

MATERIAL:
S. A. E. 3145 HEAT TREATED STEEL.

STOCK REMOVAL:
.030 INCH.

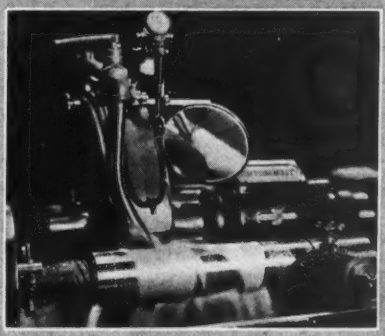
LIMITS:
PLUS. .0000 INCH. MINUS. .0002 INCH.

GRINDING WHEEL:
30 IN. BY 3 IN. BY 20 IN. 40N27 ALOXITE.

TIME PER PIECE:
35 MINUTES.

LUBRICANT:
1 PART SUNOCO TO 40 PARTS WATER.

Sunoco cools the work and produces a smooth finish



Courtesy of Cincinnati Grinders Incorporated, Cincinnati, O.

HIGH surface speeds necessitate the use of a free flowing grinding fluid, one that absorbs heat rapidly. Sunoco prevents distortion and maintains accuracy; it further permits maximum grinding efficiency through the elimination of glazing.

UNOIL COMPANY, Ltd., Montreal, Canada.

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Our cutting oil engineers will welcome the opportunity to discuss the selection and application of cutting lubricants as they apply specifically to your metal cutting operations.

Manufacturing Parts For Electric Refrigerating Units, II

Grinding Splines in Rotor—Broaching Slots in Rotor Sleeve—"Rolling" a Steam-Tight Fit

By DONALD A. CLARK

THE preceding article, in the September issue of MODERN MACHINE SHOP, told how the rotors for the refrigerating unit made by the Majestic Household Utilities Corporation, Chicago, are slotted and drilled. The next operation consists in milling the spiral oil grooves on the stem, which is done with the aid of a Pratt & Whitney thread miller. The clearance is ground on the stem, and the piece is then carburized, cleaned and hardened.

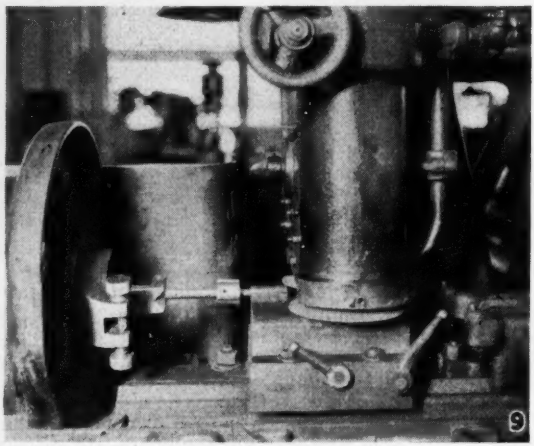
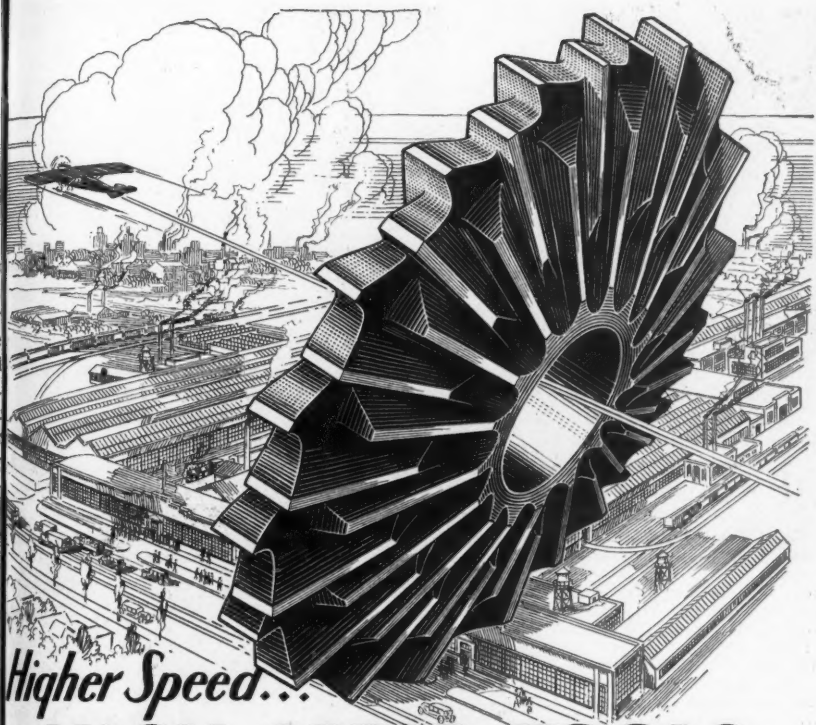


Fig. 9—Grinding vane slots in a pump rotor, using a two-spindle grinding machine.

After hardening, the four vane slots in the rotor are finished to size by grinding in a "Universal" two-spindle grinding machine as shown in Fig. 9. As indicated on the drawing shown as Fig. 2 of the previous article, the slots must be central within 0.003 in. with the center line of the rotor, the taper must not exceed 0.0003 in. on the depth or 0.0004 in. on the length, and the width of the slot must be 0.250 in. with a plus allowance of 0.0015 in. The rotor is held on centers, the center holes in the ends of the piece having been lapped to afford a positive location. The tail of the dog slips into a special holder where it is locked between two screws, this arrangement making it possible to align the slot correctly before starting to grind the first slot. The two grinding wheels are adjusted to grind the lower faces of two slots simultaneously, the piece being indexed four times to finish both sides of each slot.

The end of the rotor must be tight enough to form an air seal—practically air-tight—consequently this surface is ground also. This operation is performed in the Pratt & Whitney 8-in. surface grinder shown set up in Fig. 10. The fixture consists primarily of a steel ring in which 10 V-slots have been milled, to hold 10 rotors at a time, the pieces being held in position by means of a strap, as shown.



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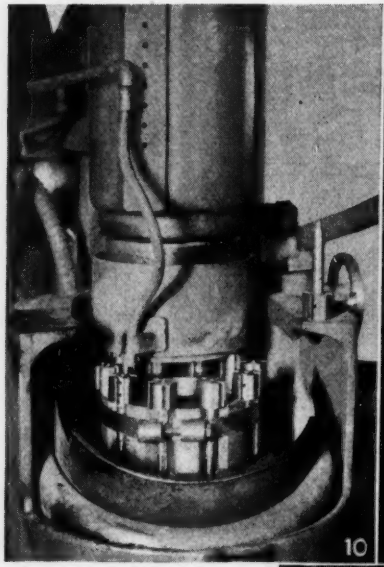


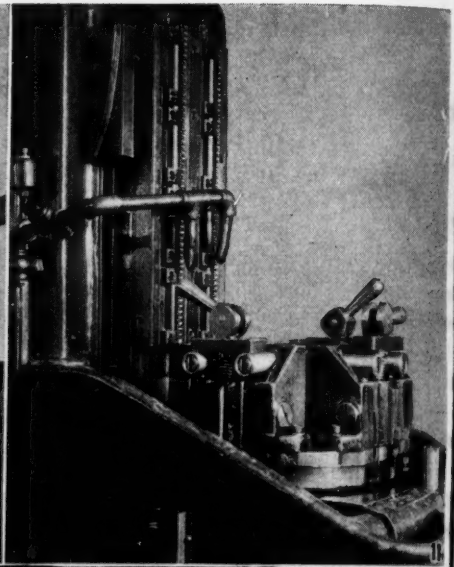
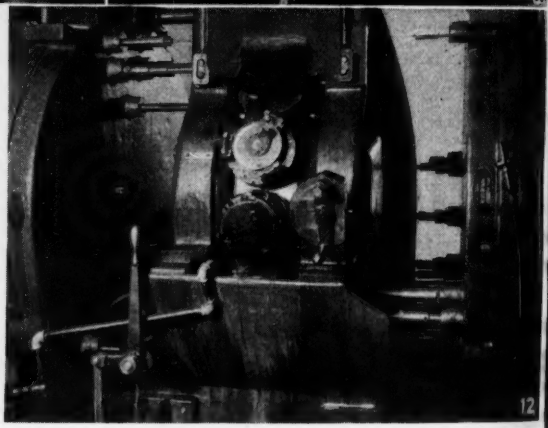


Fig. 10—Grinding the ends of the rotors. Fig. 11—Broaching slots in the ends of rotor sleeves at the rate of 400 pieces per hour. Fig. 12—This W. F. & John Barnes horizontal machine, equipped with Krueger heads, is used to drill the holes in the compressor base.



The length of the rotor-head is held to 1.2494 in., with a minus allowance of 0.0002, and this same allowance applies for variation from "flat." A production of 80 pieces per hour is obtained on this operation.

The motor rotor sleeve is a cast iron cylinder, $2\frac{11}{16}$ in. long by 1.5525 in. diameter, with a 1.1250 hole. Across one end of the sleeve is a slot 0.375 in. wide and 0.176 in. deep, which is cut in with the broaching equipment shown in Fig. 11. The machine is a Foot-Burt vertical broach, equipped to broach two slots at a time. Four fixtures are used, and the table indexes automatically from one station to the next at each downward stroke of the broach. Each fixture holds two pieces, which are held in position by a cam-action hand lever. The illustration shows the fixtures loaded for operation, and a finished piece is

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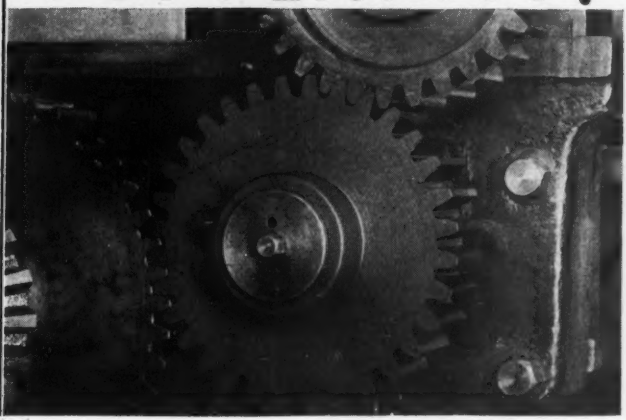

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Perfection Gear Company
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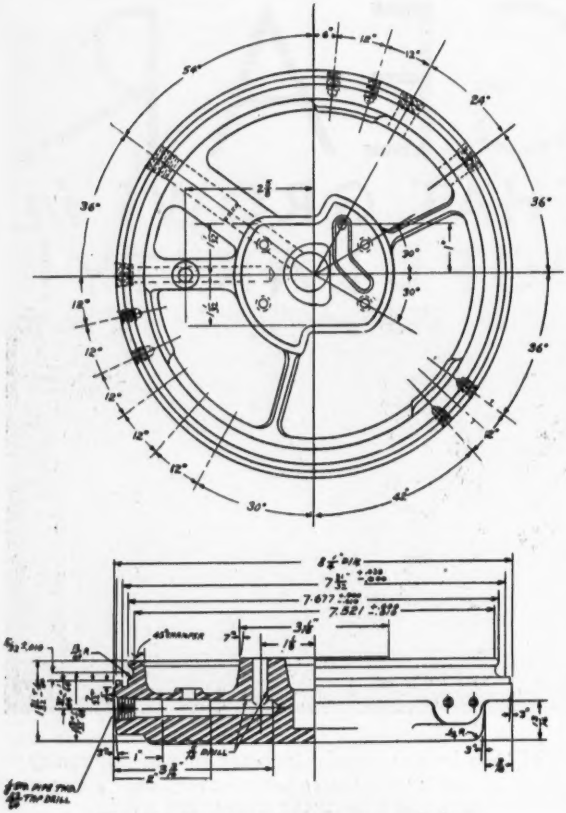


Fig. 13—Drawing of compressor unit base.

shown standing on the front part of the machine. The machine is hydraulically-operated. In operation, a movement of a lever starts the machine on a continuous cycle of operation, the broaches feeding down, returning to the starting point, and the table being indexed automatically. This cycle of operation is repeated until the mechanism is stopped. The production is 400 pieces per hour.

In Fig. 12 is shown the machine that is used to drill 13 holes in the compressor base that is illustrated in the drawing, Fig. 13. The base is of drop forged steel. The machine is a W. F. & John Barnes "chassis," equipped with Krueger heads. As the drum indexes and the pieces are presented at the several stations, six 0.205-in. holes are drilled for tapping ¼ inch, three 29/64-in. holes are drilled for tapping ¼-in. pipe thread, one hole is drilled 23/64-in. for tapping ⅛-in. pipe thread, and three holes are drilled and reamed to 0.5625 in. Each fixture on the drum indexes as the drum indexes, presenting the work in the proper position at each station. The heads are independently operated, push button switches controlling the operating mechanism. A production of 70 pieces per hour is obtained on this operation.

After the compressor unit has been assembled, it is enclosed within a dome of copper-plated steel, the dome being attached to the compressor base by rolling so as to make it completely air and steam-tight. In Fig. 14 is shown one of the machines with which the rolling operation is performed. Setting on the machine at the left is a compressor unit without the dome, and on the opposite side of the machine is a dome as it looks before it is assembled to the unit. The wall of the dome is 0.125 in. thick and the inside diameter is $7\frac{11}{16}$ in.—just large enough to slip over the top of the base easily.

In assembling the dome to the unit,

(Continued on page 49)

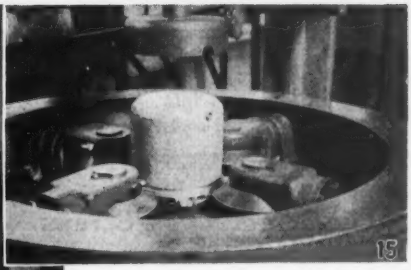


Fig. 14—The dome is assembled to the compressor unit by "rolling-in" with this machine, a steam-tight joint being obtained. Fig. 15—Here is the dome after the "rolling-in" operation has been completed.

Manufacturing Refrigerator Units

(*Continued from page 44*)

the dome is slipped over the mechanism so that the bottom edge of the dome rests in a square slot in the base. Just above the slot is a groove, cut on a 13/32-in. radius and 0.070 in. deep, as shown on the drawing, Fig. 13. The unit is placed in the machine shown in Fig. 14 and a cap is lowered over the top to hold the unit in position and also to prevent it from turning with the rollers while the machine is in operation. The operator pulls a lever, which forces four beveled rollers against the outside of the dome at a point just over the groove, and the rollers are started rotating. As more pressure is applied, the metal of the dome is forced into the groove until a steam-tight joint is obtained. A close-up view of the rollers and a dome after the rolling-in operation has been completed is shown in Fig. 15. A production of 50 pieces per hour per machine is obtained on this operation.

Armco Offers Foremen's Bulletin

The weekly bulletin that is published by The American Rolling Mill Company, Middletown, Ohio, for the benefit of the executives in its own and its customers' plants, is now offered to a limited number of the readers of Modern Machine Shop. The bulletins are directed at the reduction of operating costs in the plant, and point out common-sense methods for the foreman-manager to use. The material used is drawn largely from this company's experience with its Works Training Program in "foreman-management." A new feature has been added recently, in the form of a column of bits of pointed philosophy by business leaders, entitled "Paragraphs Worth Reading." A number of firms are using these bulletins as topics for discussion at the weekly foremen's meetings.

Machine shop executives who wish to receive the bulletins should send in their requests on their firm letterheads. Where several department heads desire copies, it is preferred that the copies be mailed together for purposes of economy. Thus if a works manager has fifteen foremen who wish to be placed on the list, the works manager's name should be sent in for fifteen copies. Address all requests to Hugh W. Wright, The American Rolling Mill Co., Middletown, Ohio. This service is gratuitous

By mentioning MODERN MACHINE SHOP when writing to the firms who are advertising in this issue, you are helping to build up a bigger and better magazine for your own benefit.

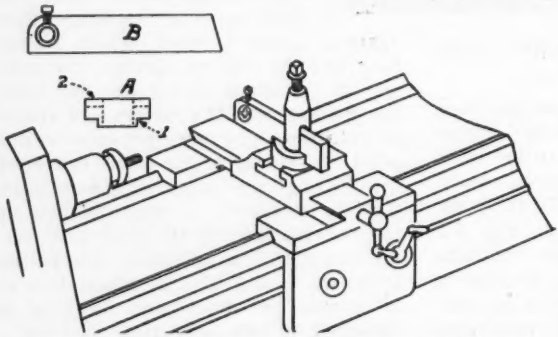
Ideas From Readers

This department is a clearing house for ideas. If there is a "kink" or short cut in use in your shop, send in a description of it. We will pay $5 for each one published.

Threading Small Screws

By P. L. BUDWITZ

IT occasionally happens that the tool room or job shop is given a job for which a quantity of small screws must be made. Usually such screws are threaded with a single-point tool before removing from the lathe, which is a slow and tedious method, especially when the screws are slender. The method described here is easier and faster, and the only special parts required are a special washer and a holder to take the ordinary button die.



Drawing illustrating method of threading small screws.

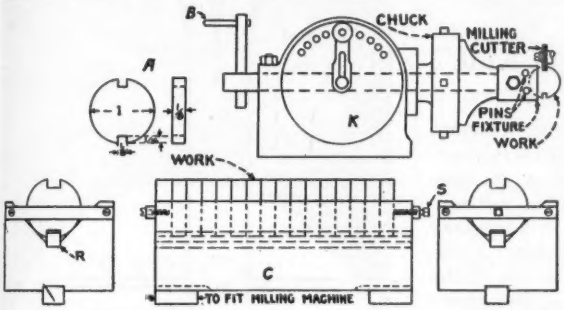
The washer **A** in the illustration takes the place of the regular concave toolpost washer in the lathe. It is made with a rib (1) which fits the toolblock, and a slot (2), cut at right angles to the rib, for the die holder. The object of the slot is to keep the die holder square with the work, and also to prevent it from slipping when in use. It is essential that the slot be of the correct depth so that when the holder is clamped in the toolpost, the center of the die will be in line with the lathe centers. The holder **B** is made from a flat piece of steel, with a hole bored and counterbored in it to take the die. The shoulder is to prevent the die from slipping through.

The lathe should be geared for the same pitch as the die, to insure an accurate lead and also to provide for easy starting of the die. No preliminary chasing is necessary when the work is turned in a chuck or spring collet. For long, slender work that is held between centers for turning, the thread is chased with a single point tool for a distance of approximately an inch, so that the die will go on easily. The piece is then taken from the lathe and the die, held in the holder, run onto the thread. It is then put back in the lathe, but the holder should not be tightened down until the half-nut is clamped on the lead screw, so that the remainder of the thread will be a continuation of the thread already cut and in the same lead. This method of threading small work saves time and eliminates a considerable amount of the trouble that is usually encountered with the ordinary chasing methods.

Cutting Opposite Keyways In Discs

By CHARLES KUGLER

THE writer was recently called upon to make a fixture for cutting keyways diametrically opposite in a number of steel discs, shown at **A** in the illustration, which had been punched out in a punch press. The price received for the job did not allow of building an expensive fixture, and the keyways had to be milled—not punched.



Drawing illustrating methods of cutting opposite keyways in discs.

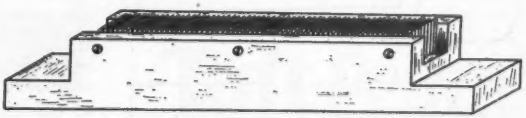
I milled the keyways in the first ones by the use of the equipment shown at **K**, which produced a good job but was entirely too slow. In using this method, the piece was held in a fixture which, in turn, was gripped in the chuck on the index head. The disc was located against two pins and clamped by means of a nut that closed the slot in which the piece was held. A bar attached to the fixture extended through the spindle and the handle **B** provided means for revolving the fixture so that both sides of the disc could be presented to the cutter. The worm wheel of the index head was disengaged.

The method described above was too slow, however, and the fixture shown at **C** was made up. This fixture consisted of a V-block with a key running longitudinally along the bottom to fit the slot in the milling machine table, and a key **R** in the apex of the V to fit the keyway in the work. The key **R** was, of course, removable. The first keyway was cut in all the pieces with the key **R** removed from the fixture, then the key was inserted and the opposite keyways were cut. Keyways were milled in 48 pieces at a setting, the pieces being held by straps across the ends of the fixture. The screw **S** in one strap was used to apply pressure against the pieces and thus hold them in position. We were able to practically double production with this fixture, although the method shown at **K** is suitable for very small quantities, and the cost of the fixture was less.

An Improvised Ratchet

By R. H. KASPER

A FINE-TOOTH straight ratchet was required recently for use on an experimental job. As the cost of machining a ratchet was prohibitive for the task in hand, the method illustrated in the drawing was used with perfectly satisfactory results. A number of hacksaw blades were cut to the required length and ground on



An improvised ratchet.

the sides to remove the "set" of the teeth, then they were nested in a housing and locked in position by setscrews. The feed per tooth of the ratchet, of course, equaled the number of teeth per inch of the saw blades. The feed can be reduced, however, by staggering the blades so that the teeth come at the required intervals. A variety of feeds can be obtained by this method.

A Useful Hardening "Kink"

By V. C. HUNTINGTON

THE piece shown in the drawing, Fig. 1, is a rotor for a refrigerating unit. It is made of S. A. E. 1350 steel, and is machined in the "green" to very close limits, as it is necessary to grind the piece all over after hardening. Before adopting the use of the equipment shown in Fig. 2, the rejections after hardening were excessively high, due to the fact that many of the pieces warped more than the 0.008 in. allowed on the reading of the indicator when the piece was revolved on centers. This amount is sufficient for rejection because of the change in relation between the four slots and the lateral axis. When the pieces were dropped into the quenching bath by

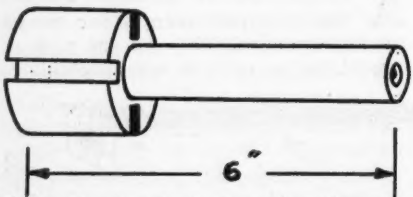


Fig. 1—Drawing of rotor for refrigerating unit.

the ordinary method, they struck the surface of the bath at various angles and at a low velocity, which combined to warp the pieces excessively. It was discovered that if the velocity of the piece was sufficient, at the time of immersion, the variation in the time of contraction of the various surfaces would not be enough to warp the piece beyond the specified limits.

To increase the velocity of the part and also to control the angle of contact with the quenching bath so that

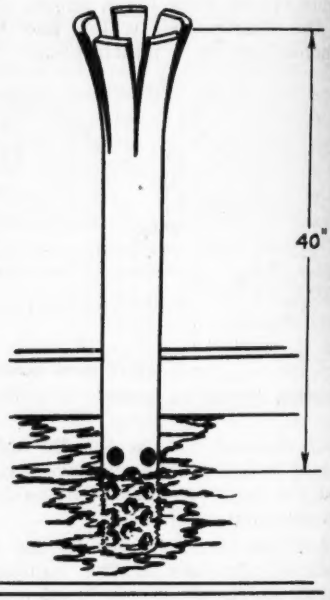


Fig. 2—Drawing of tube through which pieces are dropped into the hardening bath.

the part would be cooled on all sides at the same time, the tube shown in Fig. 2 was made and installed with the lower end projecting below the surface of the quenching bath. The tube was made from a section of standard pipe, sawed and opened out at the upper end and with a number of holes in the lower end to allow free passage of the liquid. The parts are dropped through this tube as they are taken from the furnace. Since installing this tube the rejects have been practically eliminated and the pieces are, as a whole, much straighter.

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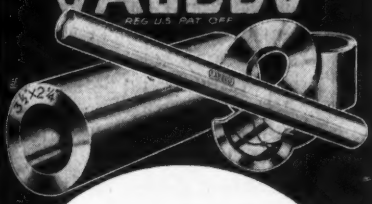

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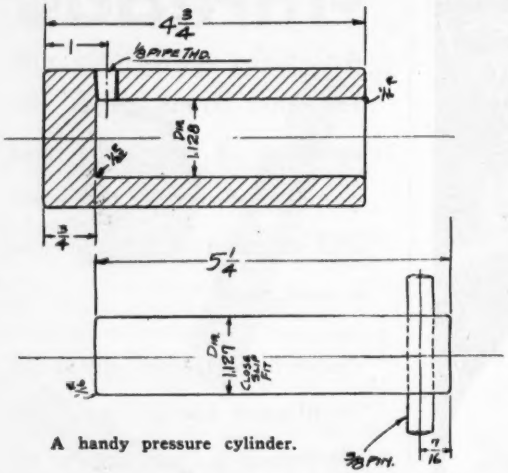
Taft-Peirce THREAD GAGES

A Handy Pressure Cylinder

By F. E. FICK

THE drawing shows the design of a simple but handy piece of apparatus, which can be used to test the strength of containers or the accuracy of pressure gages, or for other similar tasks. In its simplest form the apparatus is made as follows: A cylindrical piece of metal, about 2 in. in diameter and 4¾ in. long, is bored out to 1.128 in. diameter (equaling one square inch of area), and 4 in. deep. A ⅛-in. pipe thread hole is tapped into the cylinder at the bottom of the hole, then a plunger is made, about 5¼ in. long, of a diameter that will be a close push fit in the bore of the cylinder. A ⅜-in. pin set crosswise in the end of the plunger provides a handle by which it may be withdrawn from the hole. A pressure gage is screwed into the pipe-tap hole.



A handy pressure cylinder.

If this cylinder is filled with liquid, the plunger inserted, and pressure applied to the plunger, the pressure indicated on the gage will be the pressure per square inch applied to the plunger. A simple way to test a pressure gage is to screw the gage into the pipe thread hole, roll a platform scale under a shaper table, and bring the table down upon the end of the plunger. Whatever pressure registers on the beam of the scale should also register on the dial of the pressure gage.

If it is desired to test a tank or other receptacle for pressure per square inch, the tank should be connected by means of a copper tube and fittings to the cylinder, then the tank should be filled with liquid and the shaper table brought down on the end of the plunger as before. The pressure shown on the beam of the scale will be the pressure per square inch on the liquid in the tank. This device will be found useful for many applications.

Portable Pneumatic Bending Machine

By H. H. HENSON

THE accompanying illustration shows an efficient pneumatic bending machine that was made for use in the blacksmith shop of a southern railway shop, for both engine and car work. The particular advantage of this piece of equipment is that it can be moved about the shop, as it is mounted on iron wheels with roller bearing axles.

The machine is inexpensive to build, as the principal members are two 16x½x60-in. channel irons, one 16x12-in. Westinghouse brake cylinder, and one Westinghouse straight air brake valve "D" and hose connections. The dies A are made for bending angles and are detachable. The table "B"

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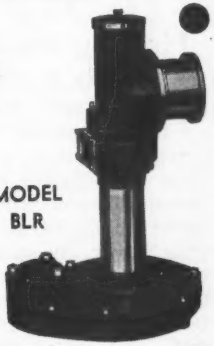

MODEL BLR

Model ULO is typical of the individual motor drive—model BLR of the belt drive.

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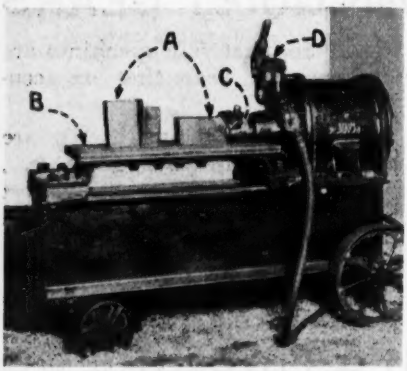
is provided with holes to accommodate the various dies and the bolts "C" hold the forming dies, making them detachable at the end of the piston



An efficient portable pneumatic bending machine.

rod. The machine shown will, when operated by one man, do work that formerly required three blacksmiths. Some of the iron can be bent cold.

Holding Small End Mills

By R. H. KASPER

SMALL taper shank end mills are not furnished with a tang, the gripping power depending entirely upon the adhesion of the tapered surfaces. Theoretically, the tapered surfaces should furnish sufficient gripping power, but such is not always the case, especially if heavy cuts are taken. Various practices are resorted to to prevent loosening of the end mill, such as coating the shank with chalk, or wrapping a piece of tissue paper around it. The writer has used both methods with more or less successful results, but the most successful method he has yet encountered is to give the shank a light copper plating, by dipping in copper sulphate solution. The soft copper gives a contact surface which greatly increases the gripping power. A few drops of nitric acid in the solution will produce a more uniform coating, but the shank should afterwards be washed in an alkali solution, such as a good cutting compound, to neutralize the acid and prevent rusting.

Calendar of Coming Events

OCT. 14-16—Annual meeting of Society of Industrial Engineers, at Pittsburgh, Penna. George C. Dent, Sec'y., 205 West Wacker Drive, Chicago, Ill.

OCT. 12-16—Twentieth Annual Safety Congress, at Civic Opera Bldg., Chicago, Ill. W. H. Cameron, Sec'y., 20 N. Wacker Drive, Chicago, Ill.

OCT. 13-16—Twenty-fifth Annual Convention of Illuminating Engineering Society, at William Penn Hotel, Pittsburgh, Penna. Sec'y., Illuminating Engineering Society, 29 West 39th Street, New York, N. Y.

OCT. 21-23—Industrial Marketing Conference, at Hotel Statler, Cleveland, Ohio. Headquarters, 20 Vessey Street, New York, N. Y.

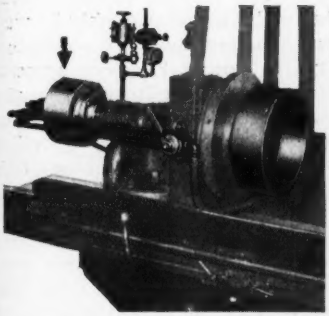
OCT. 27-29—Society of Automotive Engineers, National transportation meeting, at Washington, D. C. John A. C. Warner, Sec'y., 29 West 39th Street, New York, N. Y.

NOV. 30-DEC. 4—American Society Mechanical Engineers Annual Meeting, at Engineering Societies' Bldg., 29 West 39th Street, New York, N. Y. Calvin W. Rice, Sec'y., same address.

"Cutting and Grinding Facts"—Second Edition

Prompted by the interest with which the first edition of "Cutting and Grinding Facts" was received, the producers of "Sunoco" Emulsifying Cutting Oil have prepared a second edition. The book contains 48 pages, nearly all of which are devoted to illustrations of various types of metal-working machines in operation and data as to the operation, type of machine used, material, kind of tools used, speed, feed, amount of stock, production time per piece, and kind of lubricant used. The opportunity for comparisons by the use of this book and the information it contains should be of interest to every machine shop executive. A copy can be had by addressing the Sun Oil Company, 1608 Walnut Street, Philadelphia, Penna.

and this
INSTALLATION



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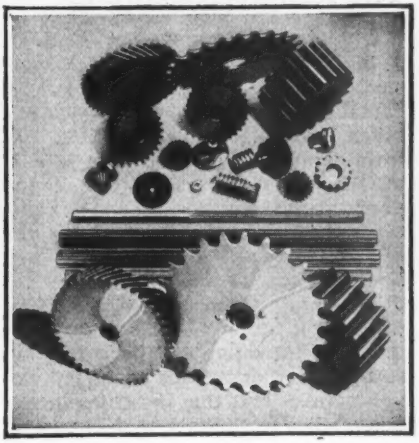

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Over the Editor's Desk

The Real Safety Director

IT is interesting to note—in journeying about the country, through small shops and large ones—the extent to which the "safety" idea has taken hold. Safety campaigns in one form or another are becoming a part of the plant routine in practically every shop, large or small. In some cases the most important part of the campaign consists in the "safety" posters that are obtained from the National Safety Council or other similar sources; in other cases safety bulletins are drawn up by the safety directors or other officials of the individual plants, but the most important feature lies in the fact that industrial executives everywhere recognize the importance of the "safety" attitude and are making definite efforts to promote it.

Regardless of who is responsible for safety in the individual plant, however, the success of the safety program rests, in the last analysis, on the shoulders of the department foreman. The safety director may give his entire time to the promotion of the safety campaign, but it is physically impossible for him to spend more than a small part of his time in any one section of the plant. The foreman, on the other hand, spends probably 95 per cent of his time in his department, and naturally falls heir to the responsibility for seeing that the safety measures which have been initiated are properly carried out, for calling attention to hazards that have been overlooked, for the proper maintenance of safety guards, and so on.

Thus the department foreman is really responsible for the success of the safety program, although in most cases he has had no special training to that end. Unquestionably he would be much better able to co-operate on safety matters if he *were* especially trained along such lines. The plant that is large enough to be divided into departments should have a well-defined plan of safety training, either by the conference method or through the periodical distribution of safety bulletins. The conference method is preferable, because it focuses attention and interest for the time being, and gives all an opportunity to call attention to hazards and suggest remedies.

The importance of the safety movement is constantly increasing. Reservations for the Safety Congress, to be held at the Stevens Hotel, Chicago, October 12th to 16th, are practically the same as in former and more prosperous years, indicating the interest that is taken in safety by the industrial leaders of the country. The 45 divisions of the program will be divided among some 350 speakers, who will discuss safety factors in relation to practically every form of industry. Safety is first in importance, and everyone who can should attend this congress.

The Hartford plant of the Underwood-Elliot-Fisher Company has reopened with a return of 2,700 employes after a full summer shutdown.

Two of the mines that were closed last spring by the Philadelphia & Reading Coal Company have been reopened.

Eight open-hearth furnaces were recently opened in the Youngstown district in one week, and production is constantly increasing.

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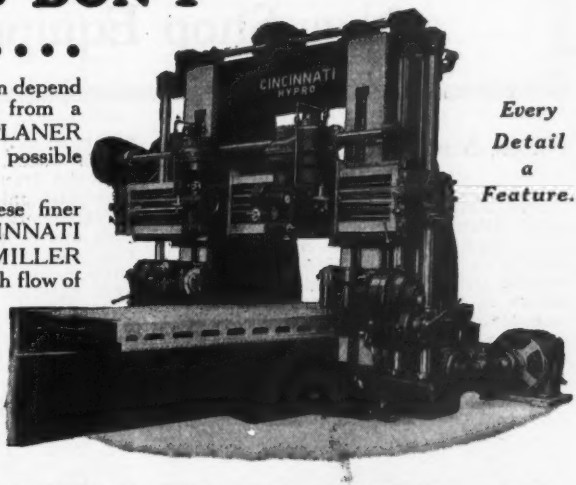

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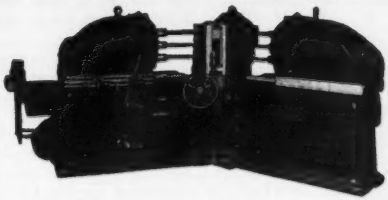
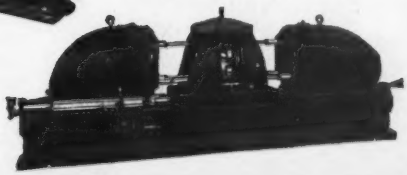


Above—Three-way Horizontal Machine, with elevating fixture, for drilling and reaming differential centers.

Below—Horizontal Duplex Heavy Duty Drilling and Reaming Machine with station type fixture.



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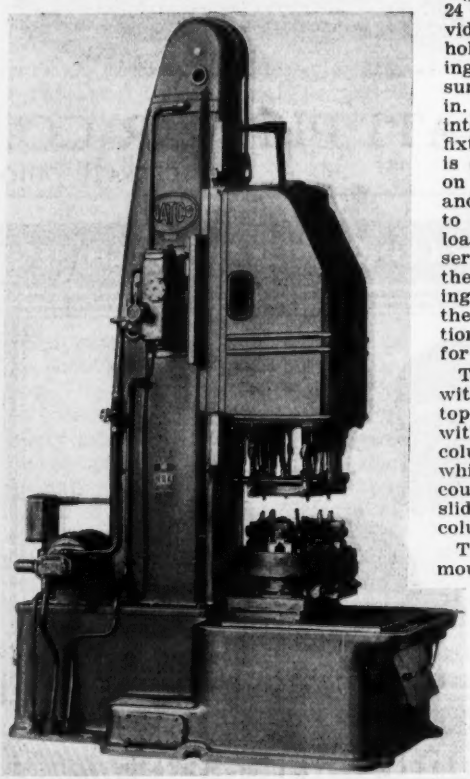
New Shop Equipment

Natco Model C-12H Hydraulic Driller

The National Automatic Tool Company, Richmond, Indiana, has brought out a hydraulic drilling machine to be known as the Natco Model C-12H Hydraulic Driller. The machine, which is shown in the accompanying illustration, was designed with the basic idea of producing a hydraulic drilling machine with the least possible number of parts. It is arranged only for the mounting of fixed-center heads, and compares in capacity with the Standard Natco 6-in. horizontal hydraulic unit. The machine is said to be extremely quiet and smooth in operation, and is intended to increase production and produce a better quality of work as well as to cut both operating and maintenance costs.



Natco Model C-12H Hydraulic Driller

The machine can be provided with either the high or low base as standard equipment. The high base has a working surface of 36 x 29 in., approximately 24 in. above the floor line, and is provided with chip chutes and a clean-out hole in the front of the base for removing chips. The low base has a working surface of 36 x 32 in., approximately 9¼ in. above the floor line. The low base is intended to be used when mounting high fixtures or where a box or rotating table is desirable when arranging the set-up on the machine. Both bases are rigid and are made with ample sections so as to withstand the thrust of the drilling load. The rear section of either base serves as a mounting platform for both the column and for the hydraulic pumping unit, which is located at the rear of the column. The inside of the rear section of either base serves as a reservoir for the hydraulic system.

The column is of the usual box section with square ways and is mounted on the top of the base, where it is anchored with heavy bolts. A top housing on the column carries a double sheave wheel on which the cables run that connect the counterweight, inside the column, to the slide which is mounted on the face of the column.

The fixed-center cluster heads are mounted in the usual manner on the head side, where they are backed up by a motor housing that takes the major portion of the drilling thrust. The heads are driven by a vertical side-mounted motor, space being provided for a motor up to and including 10 h. p. The pump unit is mounted at the rear of the column on top of the base, and consists of a motor connected directly to a constant-pressure pump. Pressures of either 200

or 300 pounds can be obtained, depending upon the motor used.

The machine is equipped with a 6-in. diameter cylinder, providing 18 in. of travel, any portion of which can be used for various feeding rates. The Standard Natco box valve mounted on the left side of the column, working in connection with trip dogs on the head slide, controls the movement of the head. Feeding pressures of either 5600 or 8000 pounds are available, and a feeding rate of 15 in. per min. can be obtained. The rapid traverse rate is approximately 80 in. per minute. The complete operation cycle is started by pulling up on the air valve handle at the right front corner of the machine, the operation being automatic. The head stops at the top of the stroke.

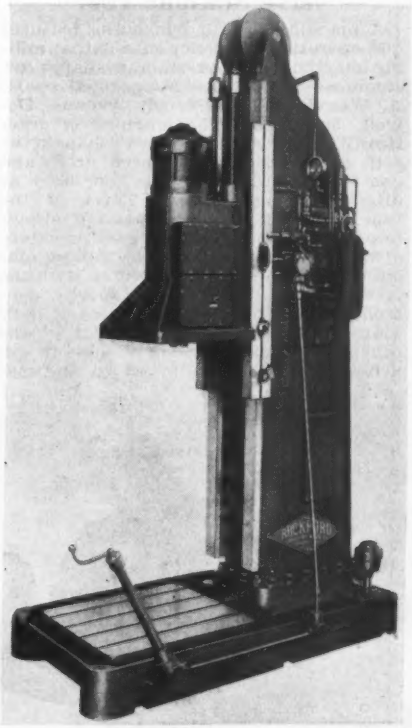
The feeding cycle may, however, be varied by the use of special valve attachments. For instance, the head may be provided with a second feed or with a jump feed, in combination with the second feed. It may also be furnished with a fixed stop and delayed reverse. All or any combination of the special features may be employed.

Both bases are provided with coolant channels of ample capacity. When required, the machine can be equipped with a coolant pump of the vertical direct motor drive impeller type, mounted on an extension of the base on the right side, just back of the working surface. The standard pump has a capacity of 9 gal. per min. with a 4-in. head, which is ample for most drilling operations on machines of this size. The approximate height of the machine is 136 in. Floor space required, 83 x 48 in. Approximate weight without heads and fixtures, 8,000 pounds.

Rockford Heavy Duty Multiple Spindle Drilling and Boring Machine

A heavy duty multiple spindle drilling and boring machine, in which the high production usually secured through the use of a single-purpose machine is combined with an unusual flexibility, has been developed by Rockford Drilling Machine Co., 10 Catherine Street, Rockford, Ill. It is said that the machine can easily be adapted for a variety of jobs. Multiple-spindle heads with the suitable number of spindles on proper centers for each job are bolted directly to the face of the drive head. The heads and tools are counterbalanced by weights which can be adjusted as required. The design of the machine incorporates an automatic operation cycle which can be varied to suit the requirements. The position of the head on the machine column can be varied as required, a travel of 24 in. being available at any position to which the head is adjusted. The base can be equipped with either a stationary or an indexing table.

The head is traversed hydraulically by



Rockford H. D. Multiple Spindle Drilling and Boring machine.

means of an Oilgear pump, driven by an individual motor and arranged for automatic operation cycle, giving a rapid traverse feed forward, an operating feed to start at a predetermined point, and rapid traverse on the return. A second rate of feed, as well as a "dwell," may be added to the automatic cycle if desired. Hand control is also available. A wide variety of speeds are available through pick-off gears.

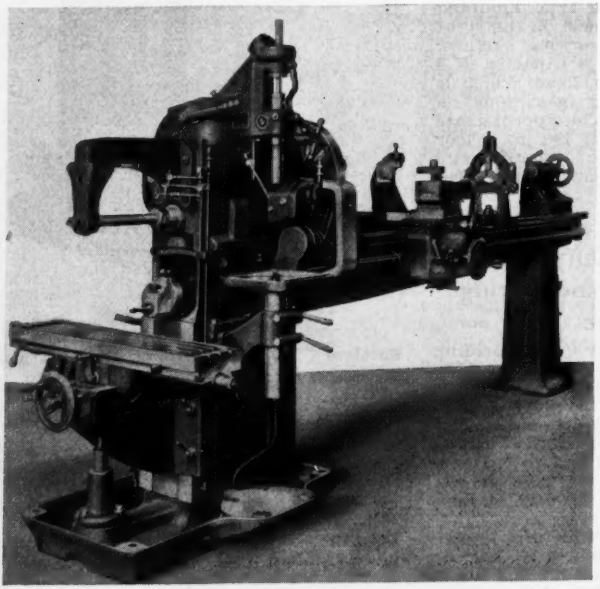
The motor drives directly into the ma-

chine head through reduction gears to the main drive spindle. Timken tapered roller bearings are included in the construction of the machine. The counterbalance weights are in laminated sections which can be added or removed through an opening in the column.

Model UM-2 Combination Universal Machine Tool

A machine tool in which the features and operating efficiency of a lathe, milling machine, drill press, and shaper are combined is now being marketed by H. A. Weaver, 8843 Livernois Avenue, Detroit, Michigan. The machine is practically a self-contained workshop in itself, as it has an all-geared drive and can be operated by either belt drive or direct-connected motor. Three of the four machines can be operated simultaneously. The lathe and drill press are always ready, and either the milling machine or shaper can be operated with the lathe and drill press. The drives, controls, and working speeds of each individual machine are independent of the others, consequently it is possible to use a heavy cut at a low speed on one machine while taking a light cut at a high speed on another of the units.

The lathe, drill press and shaper are on the same level, so that no twisting or one-sided strain can result. In case of overstraining, the machine is protected by the friction clutch of the drive pulley. For quick stopping of the entire machine, the drive shaft is provided with a coupling brake.



Model UM-2 Combination Universal Machine.

Ex-Cell-O Model 112 Diamond Boring Machine

Since the announcement of the Ex-Cell-O No. 216 Diamond Boring Machine, in November, 1930, the efforts of the Ex-Cell-O engineers have been concentrated on the development of a smaller and more compact precision boring machine for small production requirements, for use in cases where the use of the larger machine would not be justified. Such a machine, to be known as the No. 112, has been brought out by the Ex-Cell-O Aircraft & Tool Co., 1202 Oakman Boulevard, Detroit, Michigan. The design of the smaller machine incorporates the same rigidity, flexibility, and smoothness of operation that are characteristic of the No. 216 machine. The machine is single end, and is equipped with one bridge on which is mounted from one to three motor-driven boring units. Adjustment for the units is quickly obtained by means of an adjusting screw. Each boring spindle is operated by a ¾ h. p. 3600 r. p. m. motor, which is mounted on the same shaft and in the same mounting bracket with the boring spindle. This type of construction eliminates all belts, couplings, and similar drives, thereby removing the source of vibration.

The fixture table is provided with flat-end V-type ways, each way being lubricated with oil supplied automatically through air-drained valves. A large fixture pad,

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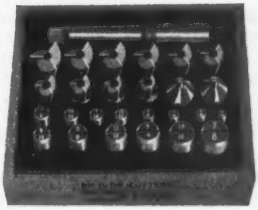

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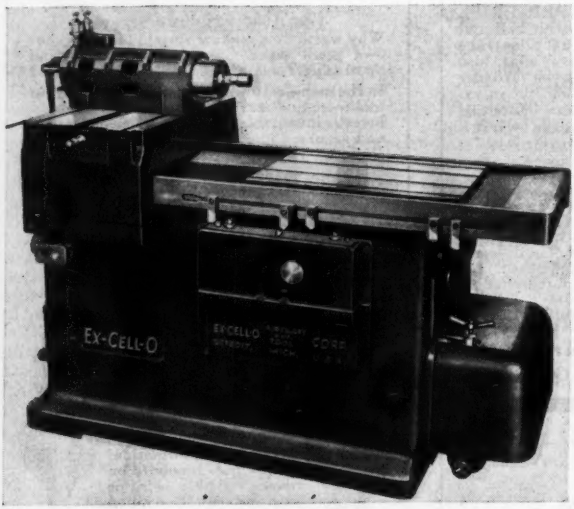
16 x 25 in., is centrally located on the table. T-slots in the pad provide for mounting fixtures, and the surfaces are scraped to insure accuracy. The table is provided with extra large coolant channels and a large drain chute with a filter basket which can be removed for dumping chips.

The hydraulic unit which operates the machine (and fixture, if required) is driven by a standard 2 h. p. 1200 r. p. m. ball-bearing motor, which is mounted on the inside of the machine as near the floor as possible to eliminate any chance of vibration. It drives both the coolant and oil pumps. Large ventilators in the bottom and side wall provide for cooling the motor. The coolant pump, hydraulic pump, and oil filter, are mounted on a bracket at the end of the machine and the whole unit is enclosed under one cover. The oil reservoir is located in the base of the machine, where it is fully enclosed.

The hydraulic system, which is low pressure, is fool-proof and gives smooth and uniform operation with feeds of 0.0005 in. per rev. of the spindle and up. Adjustable ortifices provide a range of uniform fast or slow speeds to the table during the cutting operation. The operation of the table is controlled by dogs mounted in a T-slot in the front side of the table. The dogs are adjustable for any cycle that the machine may be required to perform, and no severe shocks are present at any time during the cycle. A control button is located on the front of the machine, convenient to the operator.

The base of the machine is of rugged construction throughout, 1-in. wall thickness being maintained and a three-point floor suspension being provided. Large ribs provide maximum rigidity. The total weight of the machine, complete without fixture, is approximately 3500 lb., and the floor space required is 15 square feet.

By using suitably designed fixtures, the machine can be used for roughing only or for roughing and finishing. The design of the fixture depends entirely on the nature of the part to be bored and the production required. This type of machine is adaptable for boring pistons, connecting rods, idler gears, motor end frames, slide valve bores, and similar parts of bronze, aluminum, fiber, bakelite, and non-ferrous metals.



Ex-Cell-O Model 112 Diamond Boring Machine

McNeil "Model M" Flexible Shaft Machine

A flexible shaft machine that is said to have been designed especially to withstand the gaff of continuous service and hard usage has been placed on the market by McNeil Brothers Company, North Bend Road, Cincinnati, Ohio. The machine is adaptable for every purpose to which a flexible shaft machine can be put. The motor and operating mechanism are mounted on a plate which rests on a 5-in. ball bearing race at the top of the support column, making it possible to swivel the mechanism the full 360 degrees. The column is mounted on a heavy 65-pound base, with 3-in. diameter heavy duty double casters. The motor plate is of generous size to provide room for tools.

Power is supplied through a General Electric ball-bearing motor, either ½

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h. p. for the Model M-2, or 1 h. p. for Model M-4, and is transmitted to the shaft by a V-belt, running in cone-shaped pulleys. Minimum time in making speed changes is effected by the use

McNeil "Model M" Flexible Shaft Machine.

of an especially-designed speed change and belt adjustment feature. The machine, as shown in the illustration, is built for speeds of 865, 1750, and 3500 r. p. m. By using a high speed attachment (not shown in the illustration), three additional speeds can be obtained, up to 10,500 r.p.m. The high speed attachment, when once installed on the machine, is a permanent attachment, making the unit a two-shaft machine. Other speeds than those indicated can be provided if desired.

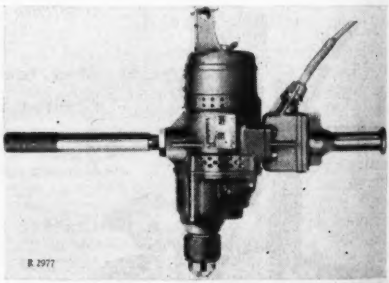
The countershaft housing is equipped with Timken Tapered Roller Bearings, and a positive contact slide coupling is provided. The shaft is the McNeil flexible shaft, made of the highest grade of Swedish steel piano wire, cold wound on a wire mandrel and with the proper number of layers and strands per layer for each size of shaft to insure the maximum of torsional strength, combined with the uniform flexibility that is necessary in order to work around curves.

The casing is made of an especially strong water-tight rustless steel tubing, reinforced with flat wire, spirally-wound. The casing will not twist or buckle under load. A vulcanized rubber type of casing can also be furnished for use where there is danger of scratching the work, although the rubber casing is not as flexible as the metallic casing. This type of casing is usually furnished with a right angle drive attachment for use on automobile body work. The hand piece is made in both ball and roller bearing types, and is designed to give the maximum of coolness, smoothness, and long life. Shaped for ease in manipulation, the strain of holding and operating the wheel or tool is reduced to the minimum.

The Model M-2 machine will operate a 6 x ¾-in. grinding wheel, 6 x 1-in. wire brush wheel, 9-in. sanding disc, or drill up to ⅝-in. diameter. The Model M-4 machine will operate an 8 x 1-in. grinding wheel, 7 x 1-in. wire brush wheel, 9-in. sanding disc, or drill up to ⅝-in. diameter. A 10-ft. super-service cord and plug are provided as standard equipment, attached to a switch box that is located so as to be at all times within reach of the operator. The complete outfit for a Model M-2 machine consists of the machine, high speed attachment, flexible shaft with hand-piece, tool box, double hand-piece, tool holder, 4 x 1-in. wire brush wheel, and 6 x ½-in. grinding wheel.

Thor "UFH" Drilling and Honing Machine

The latest addition to the Thor line of universal electric tools, manufactured by the Independent Pneumatic Tool Co., 236 S. Jefferson Street, Chicago, Ill., is the "UFH" Combination



Thor "UFH" Drilling and Honing Machine

Drilling and Honing Machine shown in the illustration. The tool is made with ball bearings throughout, and is designed to develop a maximum of power and torque. It is said that the tool will operate a hone at a faster speed than

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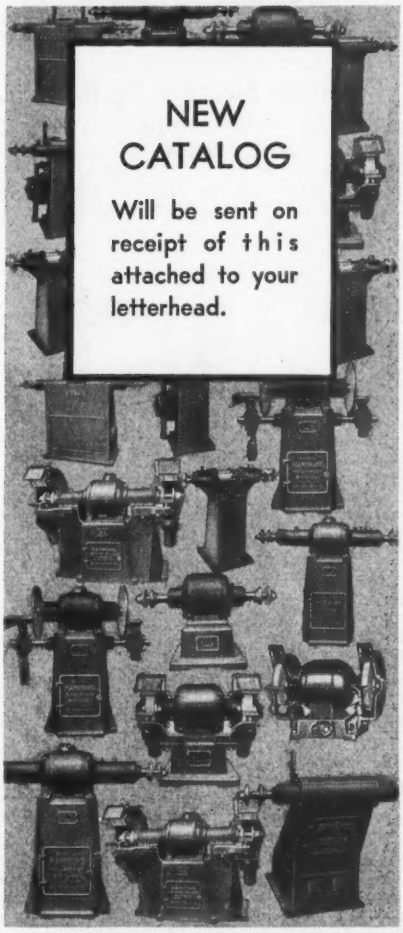

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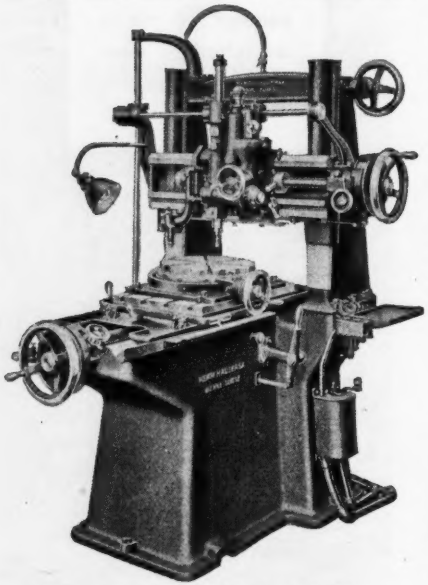
has been possible heretofore, providing an advantage in cylinder-honing in that a better and smoother job is obtained.

The drilling capacity of the tool is ⅞ in. and the reaming capacity is $\frac{9}{16}$ in. Length overall is 18 in. Spindle offset, $1\frac{13}{16}$ in. Weight, 25¾ lb. The Thor UFH drill can be had with ⅝ in. Jacobs chuck for drilling up to ⅜ in. or for driving a cylinder hone, or with No. 2 Morse taper for drilling up to ⅞ inch.

Hauser Size 3½ Jig Boring Machine

The Index Machinery Corporation, 49 Central Avenue, Cincinnati, Ohio, is now marketing the Hauser Size 3½ Jig Boring Machine, made by Henri Hauser,



Hauser Size 3½ Jig Boring Machine

Ltd., Bienne, Switzerland. It is said that this addition to the line of jig boring machines made by this firm embodies many refinements and improvements not available heretofore.

Probably the most outstanding of the new features is the device whereby perfect alignment between the cross rail of the machine, the boring spindle, and the table, is maintained at all times. This is accomplished by a series of hardened and ground locating blocks, fastened to the two upright housings of the machine and upon which suitable arms, fastened to the cross rail, rest, thereby taking the weight off the elevating screws as well as insuring absolute alignment between the essential parts of the machine.

The greatest of care has been taken in the making of the measuring screws, the screws being carefully lapped and long cams being used to correct the remaining errors, as has been the practice of the manufacturers in the building of all jig-boring equipment. This arrangement makes it possible to guarantee an accuracy of 0.00025 in. as the maximum error for the slide and table displacements.

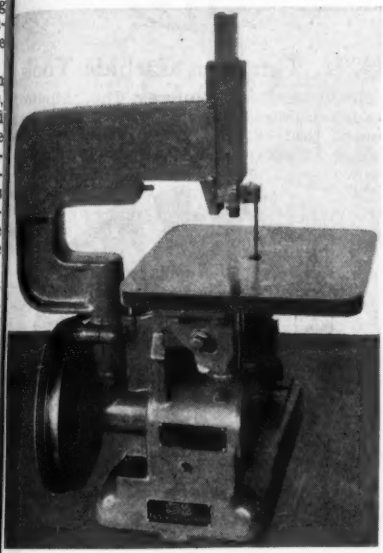
The range of the machine is as follows: Horizontal travel, 24 in.; transverse travel, 16 in.; working surface of table, 26 x 16 in., with a maximum of 24 in. between the upright housings. Equipped with a two-speed motor, the machine has a range of spindle speeds of from 50 to 1500 r.p.m. The spindle nose is equipped with a No. 2 Morse taper, and the accessories to the machine include an automatic center punch, locating microscope, drill guide attachment for small drilling, boring tools with a maximum boring capacity of 4 in., centering device, 13¾-in. circular table, and 12-in. universal tilting table. The weight of the machine is approximately 3550 pounds.

Oliver Type S-4 Die-Making Machine

The Type S-4 Die-Making Machine made by the Oliver Instrument Company, Adrian, Michigan, has been completely re-designed to include a number of features that are intended to add much to the efficiency and ease of operation of the machine. As shown in the illustration, the machine is motor-driven and can be arranged for either bench or pedestal mounting. It can also be supplied for belt drive or motor-belt drive. The table of the new model is of heavier construction, is rigidly supported on two brackets, and tilts in four directions. The working surface of the table is accurately ground.

The over-arm is used both for filing and for sawing, the upper end of the file or saw being clamped to a ram which reciprocates in bearings that are rigid and ample. The upper ram is of tool steel and is actuated through a bell

crank lever and a heavy coil spring which provides the proper, uniform tension on the saw. The over-arm may be



Oliver Type S-4 Die-Making Machine.

swung away from the file to remove the die for inspection and brought back to the same position instantly when filing is resumed. It is not necessary to remove the file or to loosen it in the lower clamp to inspect the die. The overarm is designed to eliminate the need for hold-down brackets, fingers, and file rollers which were required with previous models. Hold-down fingers are attached directly to the overarm, and the working surface of the table is entirely clear.

An entirely new type of chuck is a feature of the machine. The chuck consists of a solid and a moveable hardened jaw, the jaws being operated by means of a screw. The chuck on the lower ram and that on the upper ram are accurately aligned. The same chuck is used for holding saws, files, and lapping sticks. Every part of the machine has been designed for ease in handling and operation. The machine is rapid and accurate in both filing and sawing, and the breaking of saws has practically been eliminated.

Ramet Toolpak

The advantages and economies of Ramet, which have been available heretofore only to production plants, are now made available to the smaller user through the development of the Ramet "Toolpak"—an outfit consisting of five small but sturdy Ramet-tipped tools, a rugged toolholder, and a special grinding wheel, all packed in a finely finished wooden case. The toolbits are of various shapes, to handle a wide variety of work, and the set includes two right-hand, one left-hand, one round-nosed, and one grooving tool. The toolholder is especially designed to provide the proper support and top rake.

An important feature in the design of the toolbits is the metal of which the shanks are made. This metal is of a special type that has the same co-efficient of expansion as Ramet, and overcomes many of the difficulties that have been encountered heretofore in the use of Ramet, as the Ramet tip is not under strain. This special metal also has great advantages in the manufacture of large Ramet tools, especially those having tips of unusual size or shape.

Ramet tools should be ground on suitable wheels in order to obtain a keen cutting edge and to minimize the amount of metal removed in the sharpening process. A special grinding wheel which will fit practically any bench grinder, is sup-

Ramet "Toolpak"

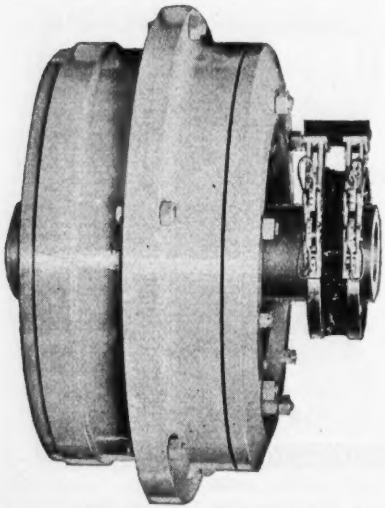
plied so that no difficulty will be encountered in sharpening the tools.

The development of the Ramet Toolpak is the result of a careful survey to determine the possibilities for the use of hard-cutting alloys in the average machine shop, during which the need for an assortment of general-purpose tools became apparent. The Toolpak provides everything necessary for the use and maintenance of the new alloys.

Stearns Multiple Disc Magnetic Clutch

The Magnetic Manufacturing Company, 635 S. 28th Street, Milwaukee, Wis., has brought out a multiple disc magnetic clutch that is said to be radically different in design and operation from all other types of magnetic clutches. The clutch is of extremely simple construction, and equally simple of operation and adjustment. It does not drive through spring plate or pins; armature and field do not move relative to each other, and the clutch is said to have virtually no moving parts such as toggles, cams, rollers, or yokes. There is practically only one wearing surface —the friction lining, which can be easily and quickly adjusted for wear.

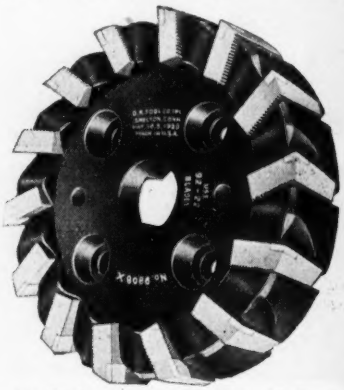
Other advantages claimed for the clutch are: small size, requiring a minimum of space for installation; heavy loads taken with ease by small diameter clutches; large friction area, due to the fact that multiple discs provide ample friction area at low pressures, and minimum of attention required for maintenance.



Stearns Multiple Disc Magnetic Clutch.

O. K. Tungsten Carbide Tools

The O. K. Tool Company, Inc., Shelton, Conn., is now putting out a complete line of tools of the well-known "O. K." design, tipped with tungsten carbide.



No. 980 Series O. K. Face Mill with Tungsten Carbide Blades.

The inserted blade system used in the design of these tools is admirably adapted for the use of tungsten carbide, and O. K. tools with tungsten carbide tips are now available for use with the milling cutters, boring and facing tools, and single tool holders in which O. K. cutter blades have been used heretofore. O. K. toolbits with tungsten carbide tips are also available in a variety of shapes for use in the O. K. toolholders designed for use in lathes, planers, shapers, boring mills, and other types of machine tools. In fact, tungsten carbide-tipped blades can be had for use in any type of holder, mill, or head with which O. K. cutter blades have been used.

Whitney No. 28 Toggle Lever Foot Press

The Whitney Metal Tool Company, 112 Forbes Street, Rockford, Ill., is now building the No. 28 Toggle Lever Foot Press shown in the illustration. The capacity of the press is a 2-in. hole in 16-gauge metal. The depth of the throat

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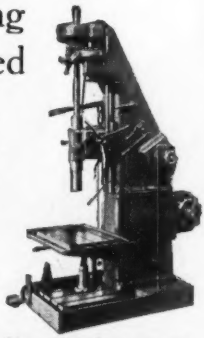

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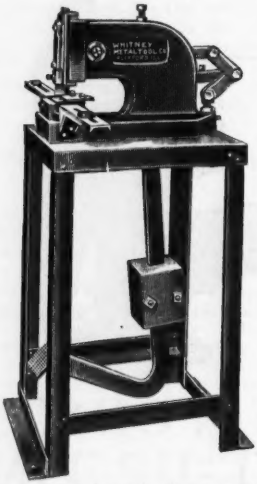
is 7 in.; height of throat, 4 in.; slug clearance hole, 2¼ x 4¼ in.; travel of ram, 1 in.

The ram is adjustable, and the press is



Whitney No. 28 Toggle Lever Foot Press.

provided with a positive stop, locking against the crank arm. The foot pedal is also adjustable. Six laminated hardened and ground tool steel plates take up the wear, and the laminated discs can be adjusted to move the stroke position of the ram ½ in. up or down. The press is equipped with a bolster plate-type die holder, and the bolster plate is provided with a T-slot to clamp on stops or stripper plates.

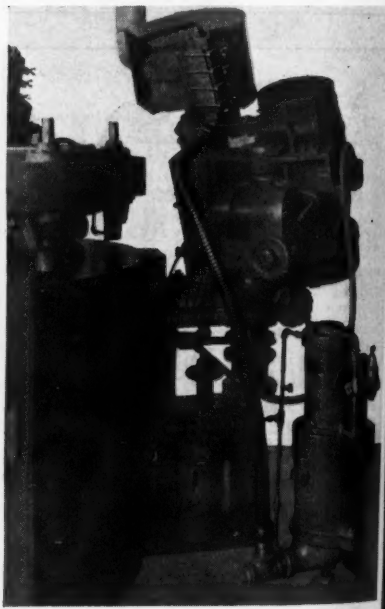
The press is also provided with a material support, together with adjustable stops on either side, and depth gage holes drilled and tapped on either side of the gear for locating the stripper fingers. The speed capacity of the machine is 100 holes per minute. All wearing parts are hardened and ground.

Hammond Automatic Composition Feeder

The illustration shows an automatic composition feeder for use in applying composition to polishing and buffing wheels on automatic, semi-automatic, and hand polishing and buffing machines that has been developed by Hammond Machinery Builders, Kalamazoo, Michigan. The feeder was designed to eliminate the hand labor usually required to apply composition to the wheels, and reduce the cost of both time and materials.

The feeder is operated by means of compressed air. The paste is delivered through a distributing nozzle directly onto the polishing or buffing wheel, the centrifugal force of the wheel carrying the composition to a collector pad which is clamped on one end of the nozzle. The collector pad presses against the polishing wheel, applying the paste. The proper amount of composition can be fed to the wheel either constantly or intermittently. If the latter method is preferred, either hand or foot control can be supplied. The feeding nozzle is equipped with adjustable discharge spout, which may be adjusted for flat, irregular, or curved contours of polishing or buffing wheels. The nozzle is supplied in sections that can be built up to lubricate any width of wheel. A flexible hose permits a wide adjustment of contact points.

Tallow, Tripoli, Stainless Steel, or White Lime can be purchased in drum containers in paste form for use with this unit.



Hammond Automatic Composition Feeder.

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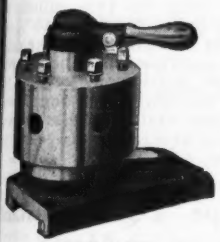

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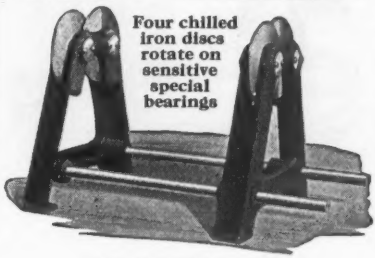
Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 in.	30 in.	2,000
60 in.	30 in.	2,000
72 in.	66 in.	5,000
96 in.	88 in.	10,000



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Thurston Improved Double-End Mill Chucks

The illustration, Fig. 1, shows a cross-section of a Thurston improved chuck holding a Thurston double-end mill, as applied to a standard milling machine spindle-nose. The chuck and mill are products of Thurston Manufacturing Co.,

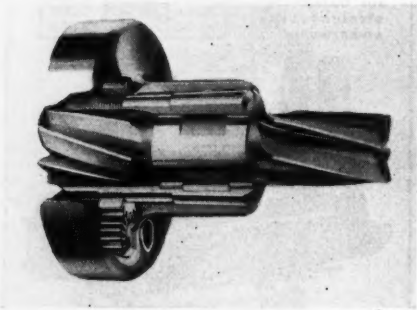


Fig. 1—Cross-section of Thurston No. S-5 Mill Chuck.

47 Borden Street, Providence, R. I. The chuck is applied directly to the nose of the milling machine, where it is fastened by four studs and driven by two large keys. The mill is held in a collet that is tightened by the "draw-in" method, the drawing-in process being accomplished through an unique mechanism that is operated from the front of the machine.

The outside of the collet is threaded, as shown, to fit a corresponding thread

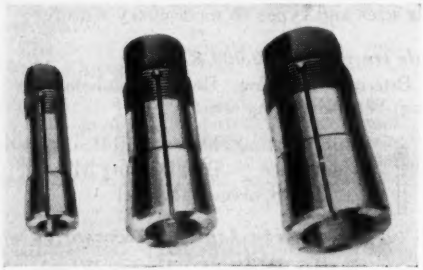


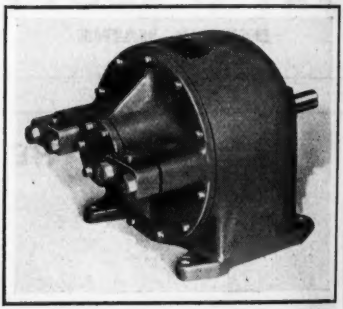
Fig. 2—Thurston Improved Collet for use in double-end mill chuck.

in the bore of a spur gear. The teeth of the gear mesh with the teeth of a pinion that can be revolved by means of a key which is inserted, from the outside, into the hexagon hole in the hub. When the pinion is revolved, the gear is revolved, in turn, thus pulling the collet in and closing it about the mill. No draw bolts are necessary. A cam locking device prevents the mill from moving either in or out, or revolving in the collet.

The chuck is made in three sizes, the No. S-1 chuck, with its two collets, to take mills from ⅛ in. diameter to ½ in. diameter; the No. S-3 chuck to take mills from ⅛ in. to 1 in. diameter, and the No. S-5 chuck to take mills from ⅛ in. to 1½ in. diameter. The Thurston double-end mills used in these chucks are standardized so that they are interchangeable in all three chucks.

Oilgear Type "RQ2" Constant Displacement Motor

The Oilgear Type "RQ2" Constant Displacement Motor shown in the illustration has been added to the line of standard equipment manufactured by The Oilgear Company, 680 Park Street, Mil



Oilgear Type "RQ2" Constant Displacement Motor.

waukee, Wis. This motor is of the constant displacement type which, when used in combination with an Oilgear Variable Delivery Pump, will provide an ideal variable speed transmission. These units can be applied to conveyors, paper mill drives, and other machinery where smooth rotary motion and variable speed are essential. Large grinding machine tables can also be reciprocated with these units, by means of a rack and pinion.

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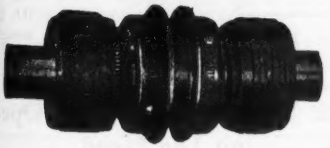

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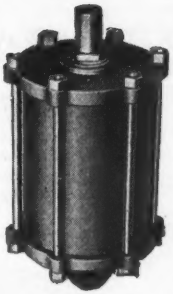

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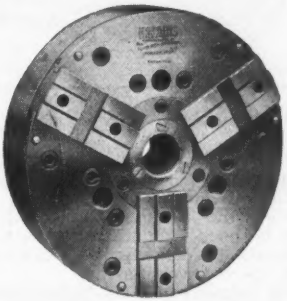

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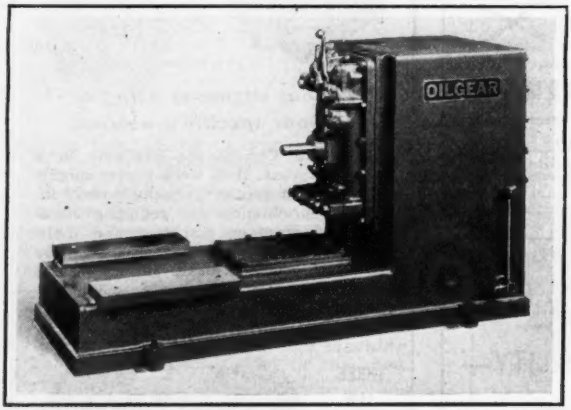
the Type RQ2 motor shaft can be varied from zero to maximum, at all times under the control of a single operating lever. The stroke of the pistons in this pump is fixed. Smooth rotary motion and positive variable speed within the rated range of the transmission is obtained with this multiple piston motor.

Oilgear Type "QR2" One-Way Variable Delivery Pump

The illustration shows the Oilgear Type QR2 Variable Delivery Pump which has been developed by The Oilgear Company, 680 Park Street, Milwaukee, Wis., for use in connection with machines performing broaching, assembling, grinding, honing, planing, drilling, boring, and similar operations where a smooth and positive straight line motion is essential. It can also be used in connection with Oilgear Constant Displacement Motors as a variable speed transmission.



Oilgear Type "QR2" One-way Variable Delivery Pump mounted on steel-welded base.

The capacity of the pump is variable from 60 to 1650 in. per min., and the maximum working pressure is 1500 lb. per sq. in. The pump will operate at speeds up to 860 r.p.m., but when run at slower speeds, the maximum deliveries are proportionately lower. The amount of power required is governed by the load, the maximum being 7 h. p. A 3 h. p. or 5 h. p. motor is sufficient for most applications.

The pump is shown mounted in a steel-welded base and arranged for direct motor drive. It is, however, mounted on a flange so arranged that the pump can be flanged into the mechanism which it operates, but when so installed an oil reservoir must be provided in the machine. The pump can also be furnished with a standard oil casing having mounting feet or with a large combination oil reservoir and base arranged for direct-connected motor drive.

The pump is of the multiple plunger type, insuring a smooth and constant volume of oil at any pressure up to its maximum. Oil is delivered in one direction only from the pressure connection on the pump. A control valve must be used for reversing the flow of oil from the pump to a reciprocating cylinder or rotary motor. The amount of oil delivered is controlled by a lever located near the top of the pump. Any delivery from 60 to 1650 cu. in. of oil per minute can be obtained instantly by adjusting the position of the control lever. A relief valve limits the peak pressure in the system and protects the pump, work, and tools against overload.

With a standard oil casing, the pump has an oil capacity of 925 cu. in. With the base shown in the illustration, the capacity is 3,000 cu. in. With the standard oil casing, the weight of the pump is 650 lb. With the base shown, the weight is 800 pounds.

H & G Style "MM" Self-Opening Die Head

The Eastern Machine Screw Corporation, Barclay and Truman Streets, New Haven, Conn., has developed a self-opening die head that uses dies of a type that makes regrinding or resharpening unnecessary. Instead of the usual large chasers of high speed steel, carriers are used that take small high speed steel inserts. Each insert is held in place by a single screw with a "draw-in" feature that locks the insert back in the carrier so as to insure trackage and even distribution of the cut. The inserts are small and inexpensive, and can quickly and easily be replaced.

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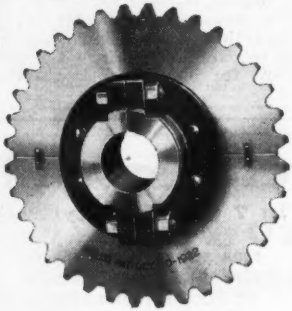

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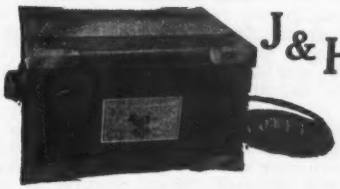

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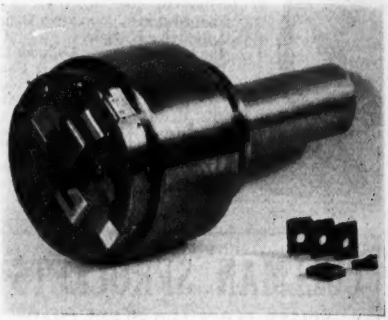
The carriers for any size of die head are made to take inserts for a definite diameter range. For example, one range includes threads up to ½ in. in diameter, another includes diameters from ½ in. to ¾ in., and so on. The same carriers are used for both the coarse and fine pitch series, as the correct helix angle is incorporated in the design of the chasers. Thus it is unnecessary to have a different set of carriers for each different thread. The carriers themselves are larger than the usual chaser, hence they have nearly twice the amount of wearing surface for contact in the carrier slots in the body of the die head.

An interesting feature is that a set of chaser inserts for cutting any given size and number of threads may be used in any size die head of this type. These heads are available at present in three sizes, designated as Nos. 101, 102, and 103.

The insert type of chaser can be so made that its initial bearing, clearances, and cutting action are in correct balance for the extreme thread accuracies now required, because no consideration has to be given to any possible change in thread-form caused by regrinding. It is said that the number of accurate threads that can be cut without removal from the die head is exceedingly large. When the insert chasers have been run to a point where threads no longer fit the gage, a new set of inserts is inserted with practically no loss of time and accurate threads are again cut with no adjustment for length of thread required.



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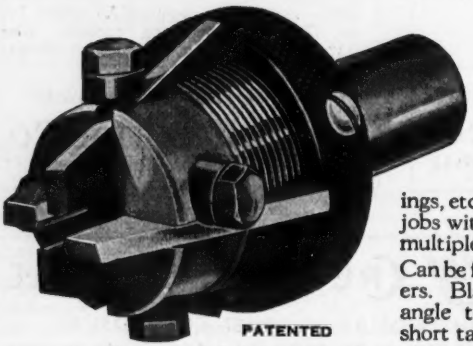

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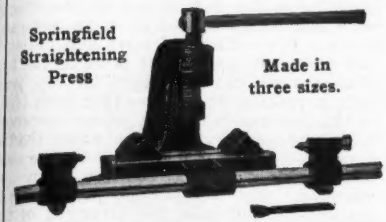

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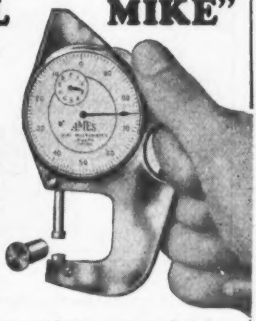

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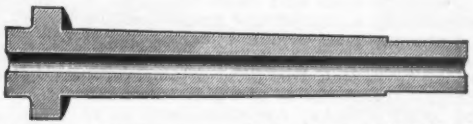

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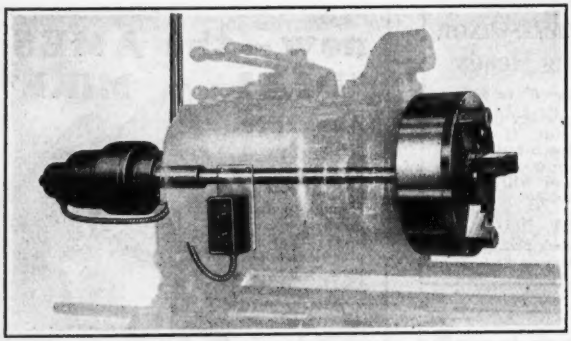
When changing chasers, it is not necessary to set the chasers for size, as practically no diameter adjustment is necessary even when shifting to another thread size.

Union Electric Power-Operated Chuck

An electric power-operated chuck that is practically instantaneous in operation, that will develop a maximum holding pressure of 12,000 pounds, and which can be operated at an average cost of two cents per day for power has been brought out by the Union Manufacturing Company, 300 Church Street, New Britain, Conn. The chuck, motor, and operating mechanism form a unit that can easily be mounted on any production machine, in the manner shown in the illustration. The average chucking time is 1½ seconds. The power cost for average work is less than two cents per day, and for production work is not more than 50 cents per month.



Union Electrically-Operated Chuck as it appears when mounted.

Power to open and close the jaws is supplied by a high-torque motor, driving a reducing gear which operates a nut and draw-bar that is attached to the wedge by which the jaws are operated direct. The motor is of 6¾ in. diameter for small chucks; for 12-in. chucks or larger, an 8-in. motor is used. The reducing gear is fitted with large ball thrust bearings and chrome nickel steel gears which run in light grease. The nut, draw-bar, and wedge are all hardened and ground.

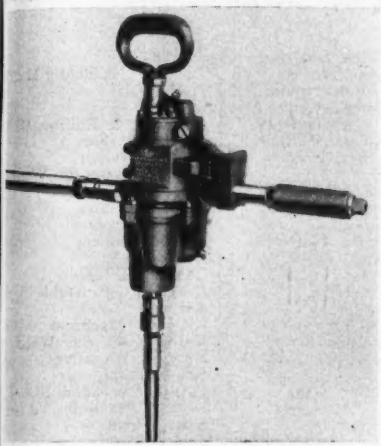
The chuck body is of forged steel with a one-piece hardened steel face that forms the ways for the master jaws. The jaws have the full range of the chuck, with power movement of ⅜ in. for each master jaw. The top jaws can be stepped along on the master jaws to the full diameter of the chuck. The top jaws lock permanently by meshing with teeth in the bottom jaws. In many instances it is unnecessary to have more than a single set of top jaws, due to the ease with which their position can be changed. The wedge-type jaw makes it possible to increase the strength of the chuck body, as the body is not cut away directly beneath the jaws. The wedge chuck is accurate to 0.001 in., and pieces can be chucked and rechucked within this accuracy.

The operation of the chuck is controlled through a push button that is located, as shown, at the front of the headstock so that the operator can hold the work with one hand and push the button with the other. Any one of four maximum jaw pressures can be obtained by plugging into any one of four outlets on the exterior of the control box with a plug that projects from the side of the control box for that purpose. Plugging into the No. 1 outlet provides power for jaw pressure for second operation work, which is comparatively light. This pressure is also used when chucking thin or light work. Plugging into No. 2 outlet provides for jaw pressure for all ordinary work. No. 3 outlet provides for jaw pressure for multiple tool cutting, and No. 4 provides the extreme holding power of 12,000 pounds. A reversing switch is provided for either outside or inside holding.

Thor No. 254R Rotary Tapping Tool

A rotary pneumatic tool especially designed for use in tapping and re-tapping stud holes and other holes in locomotive boilers has been brought out by The Independent Pneumatic Tool Co., 236 S. Jefferson Street, Chicago, Ill. The tool

is capable of tapping new holes up to and including 1 in., and re-tapping holes up to and including 1⅛ in. It is said that the time required for this work is approximately only one-fifth that required by the hand methods which were formerly used.



Thor No. 254R Rotary Tapping Tool

The light weight of the tool enables one man to handle it conveniently without assistance. While designed for tapping, the No. 254R can also be used for putting on and taking off nuts, and for screwing in cap screws, lag screws, and so on. It can also be used for tapping new threads in cylinder head castings. The tool operates at a speed of 100 r.p.m. Weight, 19 pounds. Length overall, 14½ in. The spindle is made to fit W.W. sockets only. Three sockets are included as standard equipment with each machine.

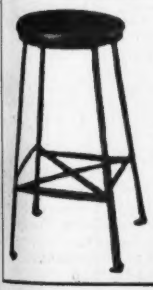
"The Export Order"

Manufacturers who are interested in the possibilities of export, but who are unacquainted with details incidental to the crating, shipping, and manner of handling the export order will find all necessary information in "The Export Order," published by G. A. F. Raland, 625 Center Street, Elgin, Ill. Mr. Raland's experience with foreign trade extends over a period of forty years, during the last twenty-three of which he has been in charge of export trade for American manufacturers.

The text starts with a discussion of the Export Order and covers the subjects of Ocean Bill of Lading, Marine Insurance, Packing and Marking, Reimbursement Terms, Foreign Customs Regulations, Credit Information, Correspondence, Preparation of Mail, Samples and Advertising Matter, Representation, Trade Marks, Cable Codes, Handling of the Export Order, U. S. Department of Commerce, and Final Remarks. Price, $1.00.

Bulletin "Keller Types G and GG Automatic Tool Room Machine"

The Keller Mechanical Engineering Corporation, 84 Washington St., Brooklyn, N. Y., has issued a bulletin describing the Keller Types G and GG Automatic Tool Room Machines. The bulletin contains twelve 8½x11-in. pages. The text discusses the Principles of Operation, Templates, and Jig Boring Feature, and includes a complete description of the machine. A number of descriptions and illustrations of dies that have been made with the machine are shown, with dimensions and figures as to the time required for production. The important parts of the machine are illustrated in detail, and complete specifications are included. Copies may be had upon application.



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Check For Information Wanted

If you are interested in prices or information on any of the equipment listed, check the item, write your name, firm name, title and address on the margin, tear out the page and send it to Modern Machine Shop, 128 Opera Place, Cincinnati, Ohio. We will see that you are supplied with the information desired.

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Selecting Grinding Wheels: The important points to be considered in the selection of grinding wheels for cutter grinding, tool grinding, surface grinding, internal grinding, or snagging are outlined in a series of folders that can be had without charge by addressing Abrasive Company, Tacony and Fraley Streets, Philadelphia, Penna.

Ames Gages: Catalog No. 50, issued by the B. C. Ames Company, Waltham, Mass., contains complete descriptions and illustrations of the dial gages, gage heads, upright gages, cylinder gages, dial micrometers, and precision verifiers, special gages and attachments made by this company. Copy free upon request.

Scraping By Power: Bearing surfaces can now be scraped with a power scraper that is quicker and easier than the old-fashioned hand method. The tool is described in a folder that is issued by Anderson Bros. Mfg. Co., 1926 Kishwaukee St., Rockford, Ill. Sent free on request.

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Stop Tap Breakage: A booklet that tells how to stop the breakage of taps, reamers, and other tools, by the use of a friction chuck, also how to use the chuck for setting studs or nuts, has been issued by The Apex Machine & Tool Co., 200 Davis Avenue, Dayton, Ohio. Sent free upon request.

Machine Shop Accessories: Catalog B-27, issued by the Armstrong Bros. Tool Co., 328 N. Francisco Ave., Chicago, Ill., describes the line of tool holders, boring tools, wrenches, pipe tools, ratchet drills, lathe dogs, and other tools manufactured by this company.

Hold Odd-Shaped Pieces Securely: A vise in which odd-shaped work can be held securely without the need of special jaws or fixtures is described in a folder that has been issued by The Avey Drilling Machine Co., P. O. Box 487, Cincinnati, Ohio. Copy free upon request.

Hobs and Milling Cutters: A complete line of milling cutters and hobs for cutting all kinds of gears, splines, sprockets and other forms is described in Catalog G issued by the Barber-Colman Company, Rockford, Ill. Descriptions and illustrations of the Barber-Colman hobbing machine and hob-sharpening machines are included. Sent free on request.

All-Geared Drilling and Tapping Machines: A catalog describing in detail the various types of all-geared, self-oiling, drilling and tapping machines made by the Barnes Drill Co., 801-851 Chestnut Street, Rockford, Ill., will be sent free upon request.

Modern Drilling Equipment: Circulars describing the various types and sizes of Barnes upright drills, multiple drills and horizontal drilling machines made by this company have been issued by the W. F. & John Barnes Co., Rockford, Ill.

Greenerd Arbor Presses: Catalog No. 36, issued by the Edwin E. Bartlett Co., Nashua, N. H., describes and illustrates all the various types and sizes of arbor presses made by this firm. Copy free upon request.

Automatic Oiled Die Sets: The automatic oiled die sets, die shoes, punch holders, leader pins, bolster plates, bushings, and other standard die parts made by the E. A. Baumbach Manfg. Co., 1806 S. Kilbourn Ave., Chicago, Ill., are described in Catalog No. 5, which has been issued by that company. Sent free upon request.

How To Sharpen Staggered Tooth Cutters, Helical Milling Cutters, and Two-Lipped End Mills: A series of pamphlets on these subjects can be obtained without charge by addressing the Brown & Sharpe Mfg. Co., Providence, R. I.

Mounted Grinding Wheels for use in small holes such as are found in bushings, dies, gears, tools, etc., are described in a catalog that has been issued by the Chicago Wheel & Manfg. Co., 110 S. Aberdeen St., Chicago, Ill. Copy free upon request.

Rapid Traverse Planers: Cincinnati Hypro Planers, made by the Cincinnati Planer Co., Cincinnati, Ohio, are described in a new catalog that has been issued by this company.

Handbook For Drillers: The Cleveland Twist Drill Co., 1242 E. Forty-ninth St., Cleveland, Ohio, has published a book in which the various parts of the twist drill are described, and which tells how to grind a drill correctly. The troubles that result from incorrect grinding are described and illustrated and several chapters are devoted to the subjects of speeds, feeds, materials, cutting compounds, and so on. Sent free upon request.

Grinding Equipment: Covel surface grinders, universal tool and cutter grinders, and Yankee drill grinders are described and illustrated in a catalog that can be had without charge by addressing the Covel Manufacturing Co., Benton Harbor, Michigan.

Motorize Your Cone Pulley Lathes: An attachment that can be applied to your lathe with four bolts makes it possible to motorize and modernize your lathes. Write for information to Cullman Wheel Co., 1336 Altgeld St., Chicago, Ill.

Davis Keyseaters: Recent developments in keyseating methods are discussed in a bulletin that also describes the keyseaters made by the Davis Keyseater Company, 250 Mill St., Rochester, N. Y. Copy free upon request.

Grinding Wheel Dressers: All of the different types of grinding wheel dressers made by the Desmond-Stephan Mfg. Co., Urbana, Ohio, including Desmond-Huntington, Desmond-Sherman, Zig-Zag, Diamo-Carbo, and diamond dressers, are described and illustrated in a catalog that has been published by the firm mentioned. Free upon request.

Precision Grinding: A booklet which describes and illustrates the most modern methods of performing all kinds of precision grinding operations, showing how the Dumore grinder can be applied to various kinds of machine tools, has been published by The Dumore Company, Racine, Wis. Copy free upon request.

Interchangeable High Production Tools: Catalog No. 28, issued free by the Eclipse Counterbore Co., 7410 St. Aubin St., Detroit, Mich., describes and illustrates the interchangeable counterbores, spot facers, end form cutters, and other end cutting tools made by this firm.

Lathe Turrets of eight different types and twelve sizes are described and illustrated in Circular No. 18, issued by Fay & Scott, Dexter, Maine. Copies free upon request.

Precision Measuring Instruments: The latest types and models of dial indicators, thread lead test gages, pitch gages, thickness gages, dial comparators, and other precision measuring instruments marketed by the Federal Products Corporation, Providence, R. I., are described and illustrated in a book that will be sent free upon application to this firm.

The Involute Gear Simply Explained: A direct, clear explanation of the theory and principles of involute gearing without the use of higher mathematics can be obtained without charge by addressing The Fellows Gear Shaper Co., 78 River St., Springfield, Vt.

Formica Silent Composition Gears: A booklet telling about the uses and advantages of Formica Silent Shock Absorbing Gears, and containing a considerable amount of valuable data with rules and tables for laying out, cutting and using gears. Sent free by Formica Insulation Co., 4632 Spring Grove Avenue, Cincinnati, Ohio.

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Tungsten-Carbide Tipped Tools: The boring tools, counterbores, form cutters, facing heads, reamers, spotfacers, and other tools made by The Gairing Tool Co., 1629 West Lafayette Blvd., Detroit, Mich., made with or without tungsten-carbide tips, are described and illustrated in Catalog No. 20. Copy free upon request.

Take Care of Your Tools by keeping them in a convenient, strong, and fine-looking chest. A catalog of tool chests, complete with descriptions and illustrations, can be had by addressing H. Gerstner & Sons, 1283 Columbia Street, Dayton, Ohio.

Machine Vises of all sizes for use with machine shop equipment are described in a circular that will be sent free upon application to The Graham Mfg. Co., 69 Willard Ave., Providence, R. I.

Greaves-Klusman Lathes: A book containing complete descriptions of the latest types of lathes made by this firm has been issued by the Greaves-Klusman Tool Co., Oakley, Cincinnati, Ohio.

Drawing Tables: The Hamilton steel-base, adjustable drawing table is described in Catalog No. 7-MS, issued by the Hamilton Mfg. Co., Two Rivers, Wis. Copy free upon request.

Grinding, Polishing and Buffing Machines of the latest types are described and illustrated in a series of bulletins that have been issued by the Hammond Machinery Builders, Kalamazoo, Mich. Copies free upon request.

Precision Bench Lathe Work can only be done on finely-built, accurate machines. The complete line of Hjorth Precision Bench Lathes is described and illustrated in a catalog that has been issued by Hjorth Lathe & Tool Company, 24 School Street, Boston, Mass. Copy free upon request.

Useful Tool Information: The Illinois Tool Works, 2503 N. Keeler Ave., Chicago, has published a catalog which describes and illustrates the standard and special cutters, mills, hobs, gear cutters, thread cutters, saws, reamers, and other tools made by this firm. The book also contains a number of useful tables and formulas. Copy free upon request.

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Oil and Waterproof Chucks: The J & H Electric Co., 202 Richmond Street, Providence, R. I., is now making a chuck that is oil and waterproof, and is designed to provide a maximum of holding surface with exceptionally strong and uniform pull throughout. Ask for complete information.

Keller Automatic Toolroom Machine for machining dies, metal patterns, jigs, core boxes, molds, and other irregular parts is fully described in a booklet that can be had free by addressing the Keller Mechanical Engineering Corp., 84 Front Street, Brooklyn, N. Y.

Threading Machinery: Catalog No. 32, containing full descriptions of Landis threading machines, stay bolt threading machines, bolt factory threading machines, automatic forming and threading machines and chaser grinders can be had without charge by addressing Landis Machine Co., Inc., Waynesboro, Penna.

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Cutter and Tool Grinding: A book that tells how to grind tools and cutters accurately and which also describes and illustrates the different types of LeBlond Universal Tool Room Grinders will be sent free upon request. Address, The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

Air-Operated Work-Holding Devices: A booklet showing how air-operated chucks and devices of various kinds can be applied to different kinds of machines to save time and labor has been issued by The Logansport Machine Co., Logansport, Ind.

Rapid-Reading Micrometer: A new type of rapid-reading micrometer, designed to show the reading in numerals, is described in Catalog No. 5, issued by The Lufkin Rule Co., Saginaw, Michigan. The catalog also contains descriptions of the micrometers, calipers, gauges, scales, squares, bevel protractors, and other tools made by this company Free upon request.

M-C Pinion Rod, made by the Meisselbach-Catucci Mfg. Co., 70 Stanton St., Newark, N. J., insures economy and accuracy in cut pinions. Send for information.

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"The Answer to Your Gear Problems": Information as to correct methods of cutting and finishing gears will be supplied without charge by The National Tool Co., Cleveland, Ohio. This firm also carries a complete stock of gear shaper cutters and markets the National-Cleveland Spur and Helical Gear Grinding Machine.

Noiseless Gears: Full details concerning a service for the accurate cutting and finishing of gears, practically eliminating noise, can be had by addressing National Broach & Machine Co., Shoemaker and St. Jean, Detroit, Michigan.

Ball and Roller Bearing Data Sheets: A complete set of data sheets showing all the dimensions and loads at given speeds, and giving instructions for mounting precision ball bearing and Hoffmann roller bearings, can be obtained without charge by addressing the Norma-Hoffmann Bearings Corporation, Stamford, Conn.

"Commercial Lapping for Close Limits and High Production" is the title of a booklet that discusses hand and machine lapping, types of lapping tools and machines, workholders for machines, preparation of lap, preparation of work for lapping and other important points. A copy may be had by addressing Norton Company, Worcester, Mass.

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(*Continued from page* 16)

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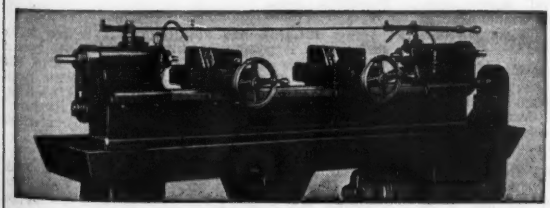

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Steel Chairs, Stools, Desks, Lockers, and other steel office and shop furniture are described and illustrated in Catalog M-731, issued by Parent Metal Products Co., Ltd., 338 North Lawrence Street Philadelphia, Penna. Copy free upon request.

"Fastenings" is the title of a booklet, issued by the Parker-Kalon Corporation, 192-196 Varick Street, New York, N. Y., in which are included the results of surveys made in fourteen different plants as to the efficiency of fastening methods. Copy free upon request.

Q-C Standardized Fixture Units in 677 sizes and 5 styles are described and illustrated in the Engineering Book put out by A. H. Pearson, 7 E. Grand Ave., Detroit, Mich. Copy free upon request.

"Most Frequent Mistakes Made in Hardening:" Users of steel can obtain a wall-chart on which are listed the most common mistakes made in hardening tool steels, results of mistakes as shown on the tools, appearance of fracture, and suggestions for remedying the mistakes, by writing to the Poldi Steel Corporation of America, 247 West 18th Street, New York, N. Y.

Better Tool Work at Lower Costs can be obtained with the Pratt & Whitney Model B Lathe, described in an illustrated circular which can be had for the asking. Address Pratt & Whitney Co., Hartford, Conn.

Shape or Slot With This Machine: The Rhodes Convertible Shaper, made by The Rhodes Manfg. Co., Waltham, Mass., can be used for horizontal shaping or vertical slotting. Details upon request.

Bench Lathe Mounting and Driving Equipment: Bulletin 120-A, issued by Rivett Lathe and Grinder Corporation, Brighton, Mass., contains complete descriptions and illustrations of modern and conventional countershaft, individual motor drive jackshaft, and speed box motor drive, also benches, cabinets, oil pans, etc. Copy free upon request.

Fullmore Industrial Clutch: A multiple disc clutch, made in two types, to run in oil or dry, and which is so built that it can be operated at high speeds, is illustrated and described in a folder that will be sent free by the Rockford Drilling Machine Company, Rockford, Ill.

Automatic Lubrication: Individually motor-driven pumps that keep the work flooded with lubricant are described in a booklet that has been published by the Ruthman Machinery Co., Front and Pike Sts., Cincinnati, Ohio.

Electric Tools: The complete line of "Ideal" electric drills, screwdrivers, nut setters, and grinders of various types is described and illustrated in Catalog No. 30, issued by The Schauer Machine Co., 907 Broadway, Cincinnati, Ohio. Copy free upon request.

Stamp Your Name on Your Product: Full information as to the steel roller dies made by The Schwerdtle Stamp Co., 10 Cannon Street, Bridgeport, Conn., can be obtained by writing this firm.

Push-Broaching With Modern Equipment: Modern methods of finishing holes by push-broaching, are described in a booklet that is issued free by the Sheldon Machine Co., 3255 Cottage Grove Ave., Chicago, Ill.

Simonds Files: A useful book on files showing the various styles made, their uses, cross-section, and cuts, and containing a number of reference tables and other information useful in a machine shop can be had by addressing Advertising Dept., Simonds Saw & Steel Co., 470 Main Street, Fitchburg, Mass.

The Most Efficient Speed for the operation of special production units, power conveyors, and other machinery by the use of the WHS Speed Reducer and how it can be obtained is told in a bulletin that will be mailed free by Winfield H. Smith, Inc., 30 Eaton St., Springville, N. Y.

Speed and Accuracy in Straightening: The Springfield Straightening Press is an ideal tool for use in straightening any length or size of rough or finished work. Send for illustrated folder. Address The Springfield Machine Tool Co., 630 West Southern Avenue., Springfield, Ohio.

Stackbins Save Space: Bins which may be used as individual containers, as tote-boxes, or "nested" to form stock-room sections are described in an illustrated circular published by the Stackbin Corporation, Pearl and Rice Streets, Providence, R. I.

Cutting and Grinding Facts: A discussion of cutting oils and lubricants, together with descriptions and illustrations of various kinds of jobs upon which cutting oils are used, is contained in a booklet that is issued by the Sun Oil Company, 1608 Walnut Street, Philadelphia, Penna. Free upon request.

Rigidmilling Principles and Practice: A book that shows how the Rigidmil can be adapted to various kinds of usual and unusual milling operations, and which describes in detail the work that can be handled by this machine has been issued by the Sundstrand Machine Tool Co., Rockford, Ill. Copy free upon request.

Snap, Plug, Ring, and Thread Gages: The complete line of precision gages made by The Taft-Peirce Manufacturing Co., 32 Mechanic Ave., Woonsocket, R. I., is described in a folder which can be obtained, free by addressing this company.

Penetrating Oil for High-Speed Equipment: Three-In-One Oil, blended scientifically from animal, mineral and vegetable oils, will penetrate the tightest bearings and lubricate high speed units perfectly. Full information can be had by writing Three-In-One Oil Co., Dept. 96, 130 William St., New York, N. Y.

Chuck With Air: How time and labor can be saved by the use of air-operated chucks, cylinders, and other equipment is told in a book which describes "Hopkins" Air-Operated Equipment. Published by The Tomkins-Johnson Company, 620 N. Mechanic St., Jackson, Mich. Sent free upon request.

Change drilling speeds instantly without stopping the machine or touching a belt. This can be done with the Victor Super-Drill, made by U. S. Automatic Box Machinery Co., Newtonville, Boston, Mass. Bulletin free upon request.

Electrically-Driven Portable Tools: The "U. S." line of electric drills, die grinders, electric screw drivers, surface grinders, tool post grinders, and bench and floor grinders is described in Catalog No. 29, which has been published by The United States Electrical Tool Co., 2471 W. Sixth St., Cincinnati, Ohio.

Wappat "Red Streak" H. D. Electric Drills that cannot be stalled by any hand drilling test are fully described and illustrated in a catalog that can be had by addressing Wappat, Incorporated, 7522 Meade Street, Pittsburgh, Penna.

Power Drive in Any Position: The modern flexible shaft makes it possible to drive all kinds and types of tools in places and positions impossible of access with straight-shaft machines. Ask The S. S. White Dental Mfg. Co., Industrial Division, 150A West 42nd Street, New York, N. Y., for the "Flexible Shaft Handbook." Copy free to any mechanical executive addressing this firm on his firm letterhead.

Wrenches For Every Use: "Guaranteed Against Breakage" tappet wrenches, pipe and fitting tongs, offset wrenches, and wrenches for all other uses are described and illustrated in a series of folders which can be obtained without charge by addressing J. H. Williams & Co., Buffalo, N. Y.

In Cleveland-It's
THE HOLLENDEN
at
REDUCED RATE
Now Starting at $2.50 Single · WITH BATH

FOUR-station radio in every room of this most popular hotel, already famed among experienced travelers for its homelike comfort, good food and excellent service.

The $2.50 Single, base rate, is effective in these DeWitt Operated Hotels:

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DeWITT OPERATED HOTELS

Sometimes WE *are surprised*

BUT we try not to show it... This time a husband said his wife was arriving in 10 minutes, and could we help him arrange a surprise dinner party for her? Here was a list of 12 guests ... would we telephone them and "fix things up" while he dashed to meet his wife at the station? There were 14 at that dinner ... and his wife *was* really surprised!

It's our belief that a hotel should do *more* than have large, airy rooms, comfortable beds, spacious closets. Beyond that, we daily try to meet the surprise situation *(without surprise)*, no matter what the guest wants.

UNITED HOTELS

UNITED HOTELS

By GEO. ALEXANDER MANN

Then It Happened

He found she'd used his razor
To open cans o' stuff,
And so for a shoe brush
He used her powder puff.

Dad says the only time he ever got home an' found the dinner burned wuz when they'd had a fire at the delicatessen.

An' Get Toed Vociferously

Be careful when you set out to make somebody toe the mark—You may turn out to be the mark.

In the old days when we reached the hotel they put our luggage in the check room. Now they put it on ice.

Sez Willie

Janes are biased,
They've broke me flat,
It's "bias" this
An' "bias" that.

Daughter, beware o' the bad egg; you may want to drop him.

Faulty Is Right

As a druggist,
He is faulty,
All his salads
Are too salty.

One o' the saddest experiences in a married man's life is to go home to relax an' find a house fulla antique furniture.

If you don't think it takes push to get anywhere, buy a used car.

Her skirts may measure a sixteenth of an inch or so longer, but from all appearances, when she gets a shoe on each foot, she's two-thirds dressed.

Where once we had bread to cast upon the water, now we have wheat to dump in the ocean.

Derned Embarrassin'

The low-down price o' eggs
Has stopped hens to a hush,
Now instead o' cacklin'
When they lay one, they blush.

A pessimist is any guy who can't kid himself.

Paw Knows

"Is it because o' my youth,
You're objecting, dear Dad?"
"Yeh," said Paw,
"He's a hopeless cad."

These days it's a heckova drug store that don't handle lawn mowers.

Sellin' on commission is one thing. Bein' sold on the Wickersham Commission is something else again.

You've Seen 'Em

She may have blue eyes,
Ruby lips to boot,
An' still look a wreck
In a bathin' suit.